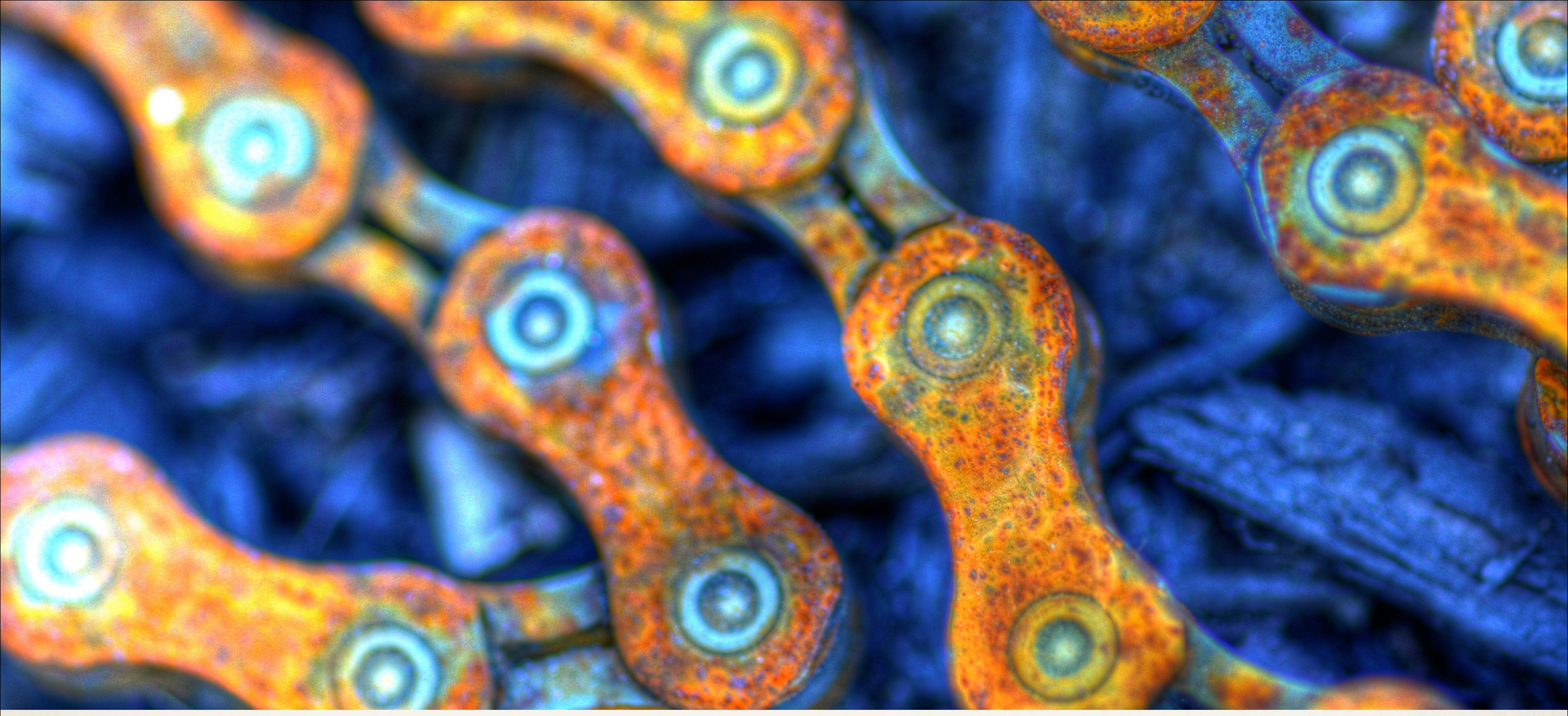

Level 2:
Indoor Cycling Workshop

Lisa A. Workman

Saturday, February 22, 2014

Overview

- Introductions
- Past to Present
- Exercise Physiology 101
  - Muscle, Heart and Lungs
- The Three Energy Systems
- Training Continuum
- Drills and Skills

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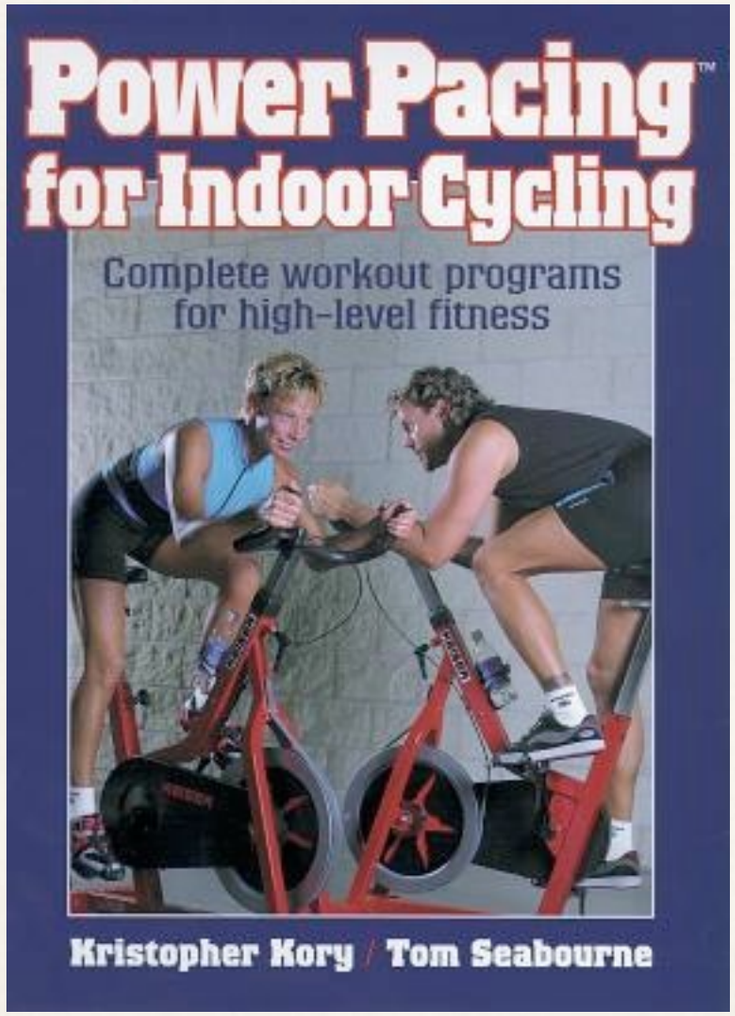
Past to Present



1990's

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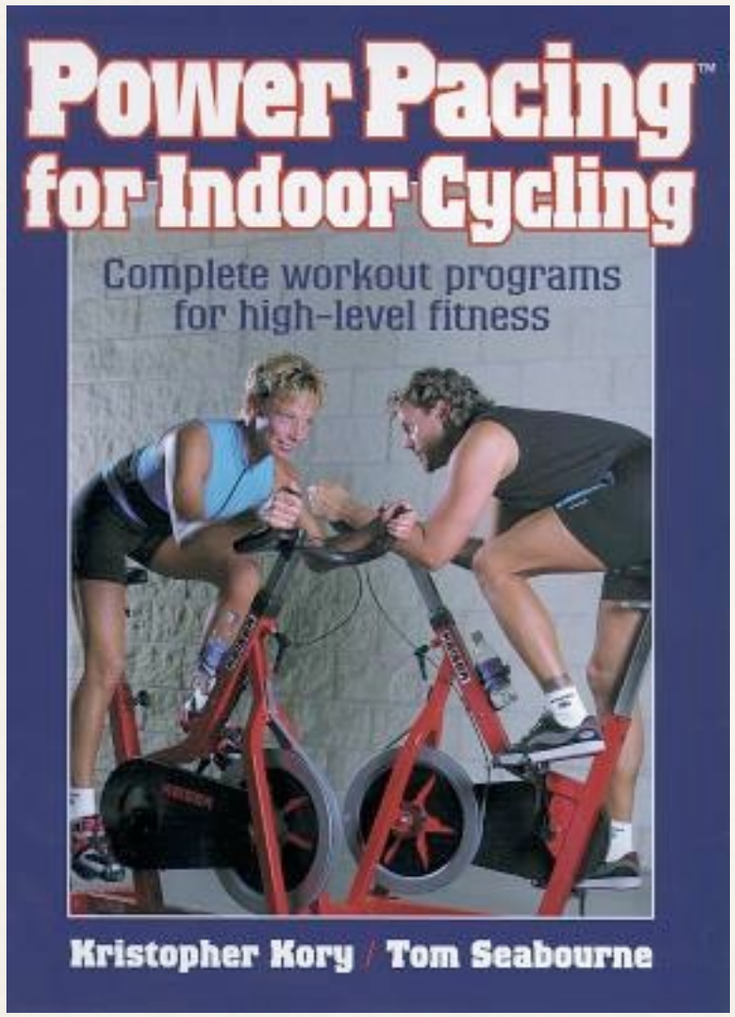
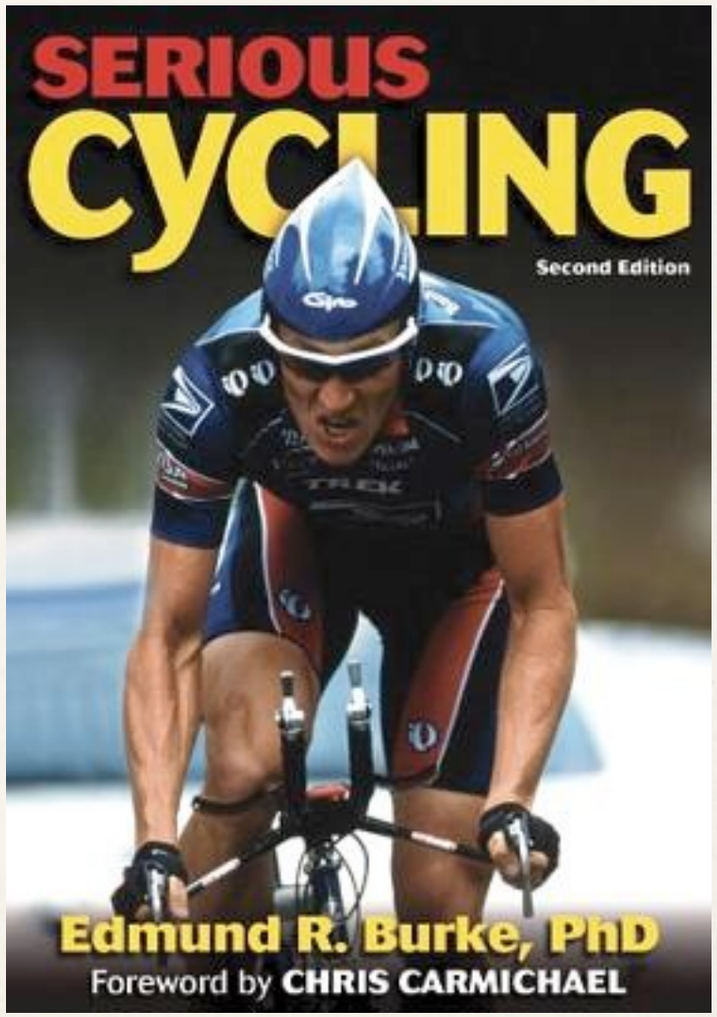
Past to Present



1990's



Present Day

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Building Blocks - Where We are Going

Drills and Skills

Training Continuum

Energy Systems

Exercise Physiology

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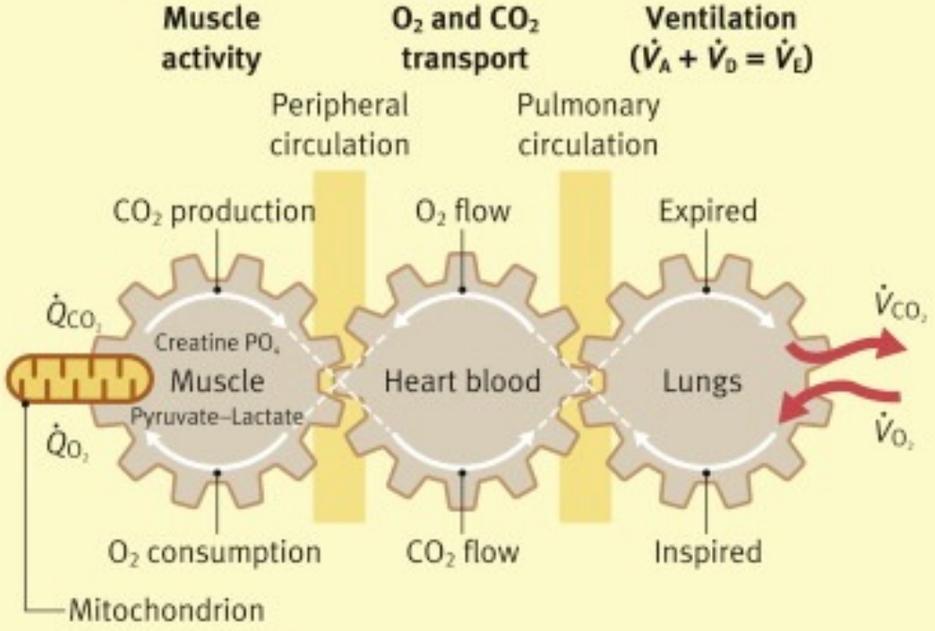
Exercise Physiology 101

The interaction among the pulmonary, cardiovascular and skeletal muscle systems during exercise



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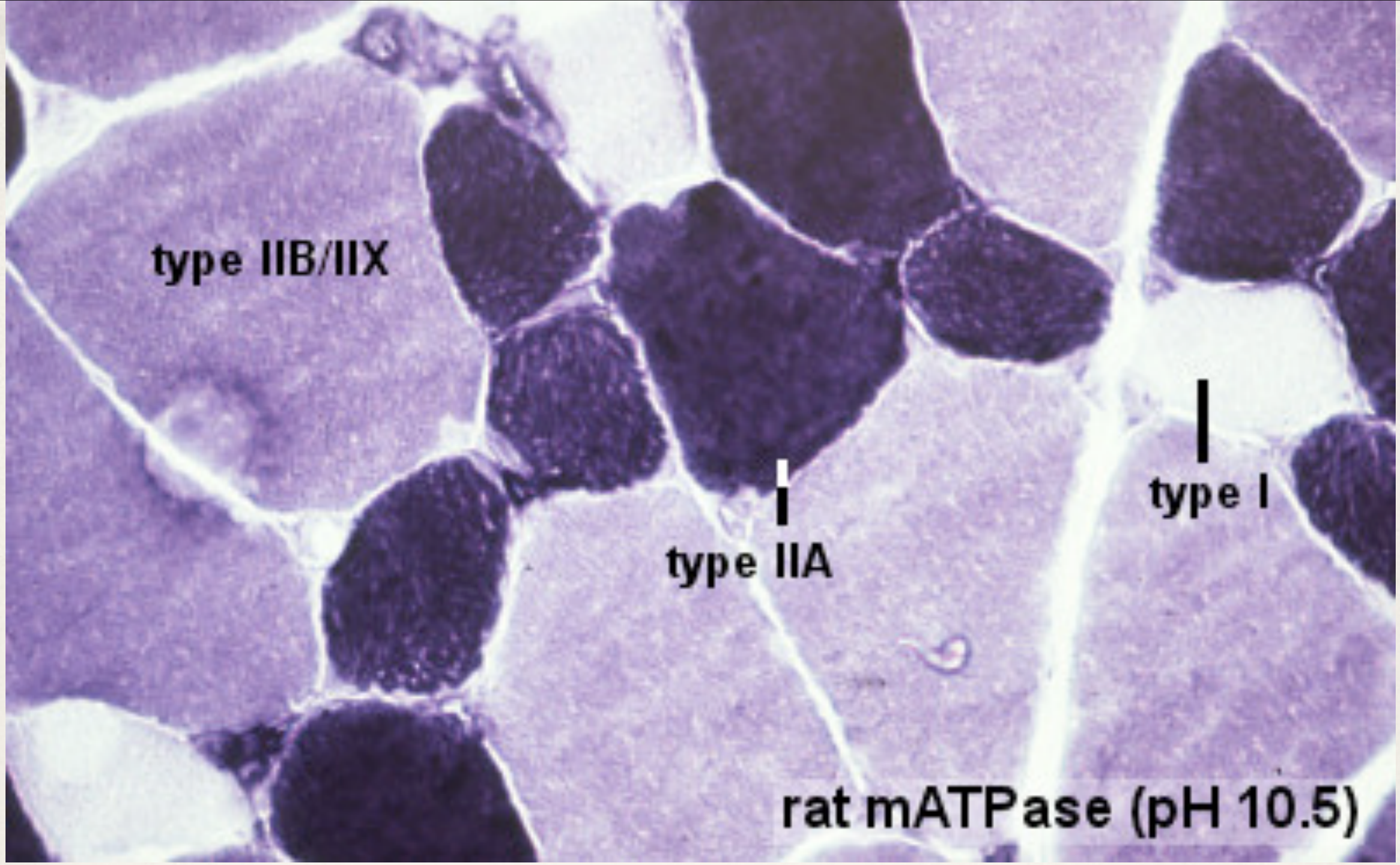

Muscle: The First Cog in the System

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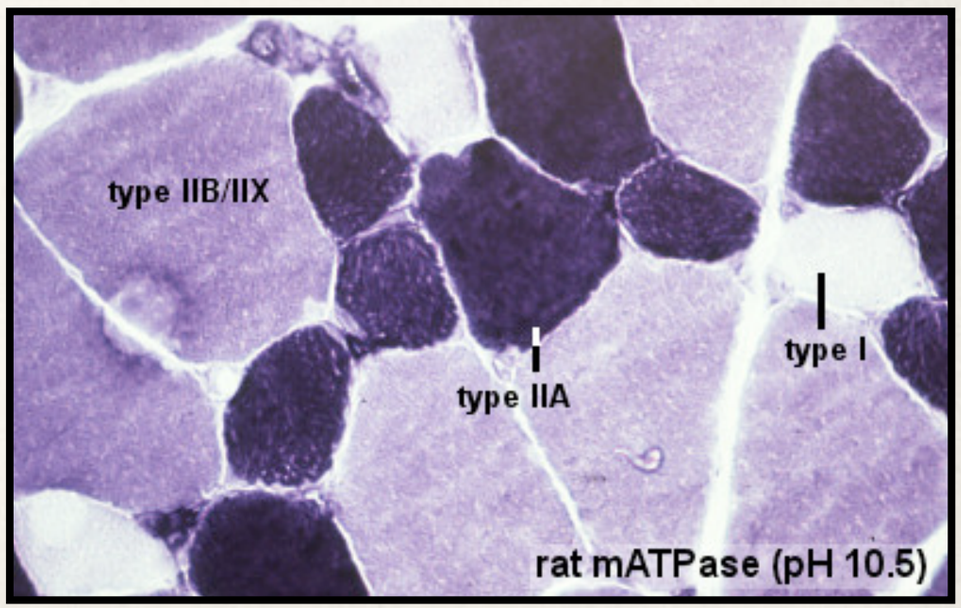
Muscle: The First Cog in the System

- Three types of muscle fibers:
  - Slow Twitch (Type I) Muscle Fibers
  - Fast Twitch (Type IIa) Muscle Fibers
  - Fast Twitch (Type IIb) Muscle Fibers
  - Others?



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Terms

Contraction Time	How fast a muscle contracts
Size of Motor Neuron	The size of the electrical carriers
Resistance to Fatigue	
Activity	How the muscle gets energy
Force Production	
Mitochondrial Density	How many "cellular power plants"
Capillary Density	How much blood is present
Oxidative Capacity	How the muscle uses oxygen
Glycolytic Capacity	How the muscle uses glucose
Major Storage Fuel	

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Slow Twitch (Type I) Muscle Fibers

Contraction Time	Slow
Size of Motor Neuron	Small
Resistance to Fatigue	High
Activity	Aerobic
Force Production	Low
Mitochondrial Density	High
Capillary Density	High
Oxidative Capacity	High
Glycolytic Capacity	Low
Major Storage Fuel	Triglycerides

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Fast Twitch (Type IIa) Muscle Fibers

Contraction Time	Fast
Size of Motor Neuron	Large
Resistance to Fatigue	Intermediate
Activity	Long-term Anaerobic
Force Production	High
Mitochondrial Density	High
Capillary Density	Intermediate
Oxidative Capacity	High
Glycolytic Capacity	High
Major Storage Fuel	Creatine Phosphate, Glycogen

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Fast Twitch (Type IIb) Muscle Fibers

Contraction Time	Very Fast
Size of Motor Neuron	Very Large
Resistance to Fatigue	Low
Activity	Short-term Anaerobic
Force Production	Very High
Mitochondrial Density	Low
Capillary Density	Low
Oxidative Capacity	Low
Glycolytic Capacity	High
Major Storage Fuel	Creatine Phosphate, Glycogen

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Characteristics of the Three Muscle Types

	Slow Twitch (Type I)	Fast Twitch (Type IIa)	Fast Twitch (Type IIb)
Contraction Time	Slow	Fast	Very Fast
Size of Motor Neuron	Small	Large	Very Large
Resistance to Fatigue	High	Intermediate	Low
Activity	Aerobic	Long-term Anaerobic	Short-term Anaerobic
Force Production	Low	High	Very High
Mitochondrial Density	High	High	Low
Capillary Density	High	Intermediate	Low
Oxidative Capacity	High	High	Low
Glycolytic Capacity	Low	High	High
Major Storage Fuel	Triglycerides	Creatine Phosphate, Glycogen	Creatine Phosphate, Glycogen

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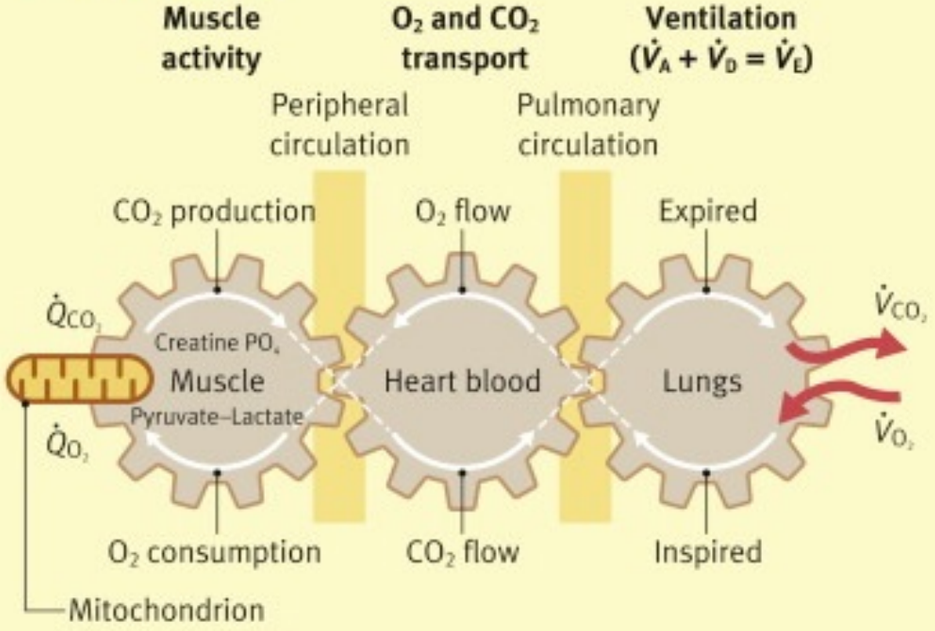
Exercise Physiology 101

The interaction among the pulmonary, cardiovascular and skeletal muscle systems during exercise



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Heart: The Second Cog in the System

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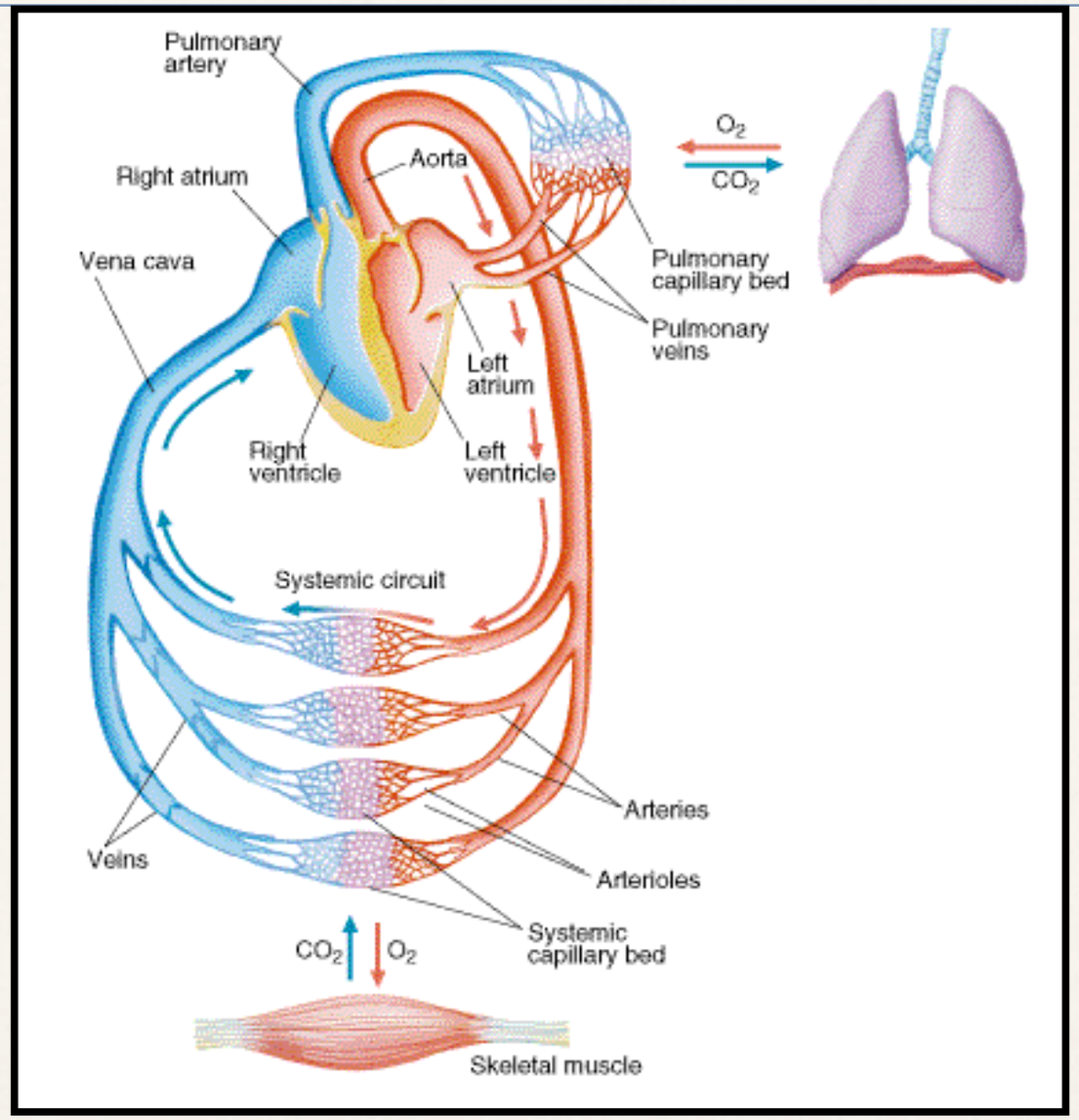
Heart: The Second Cog in the System



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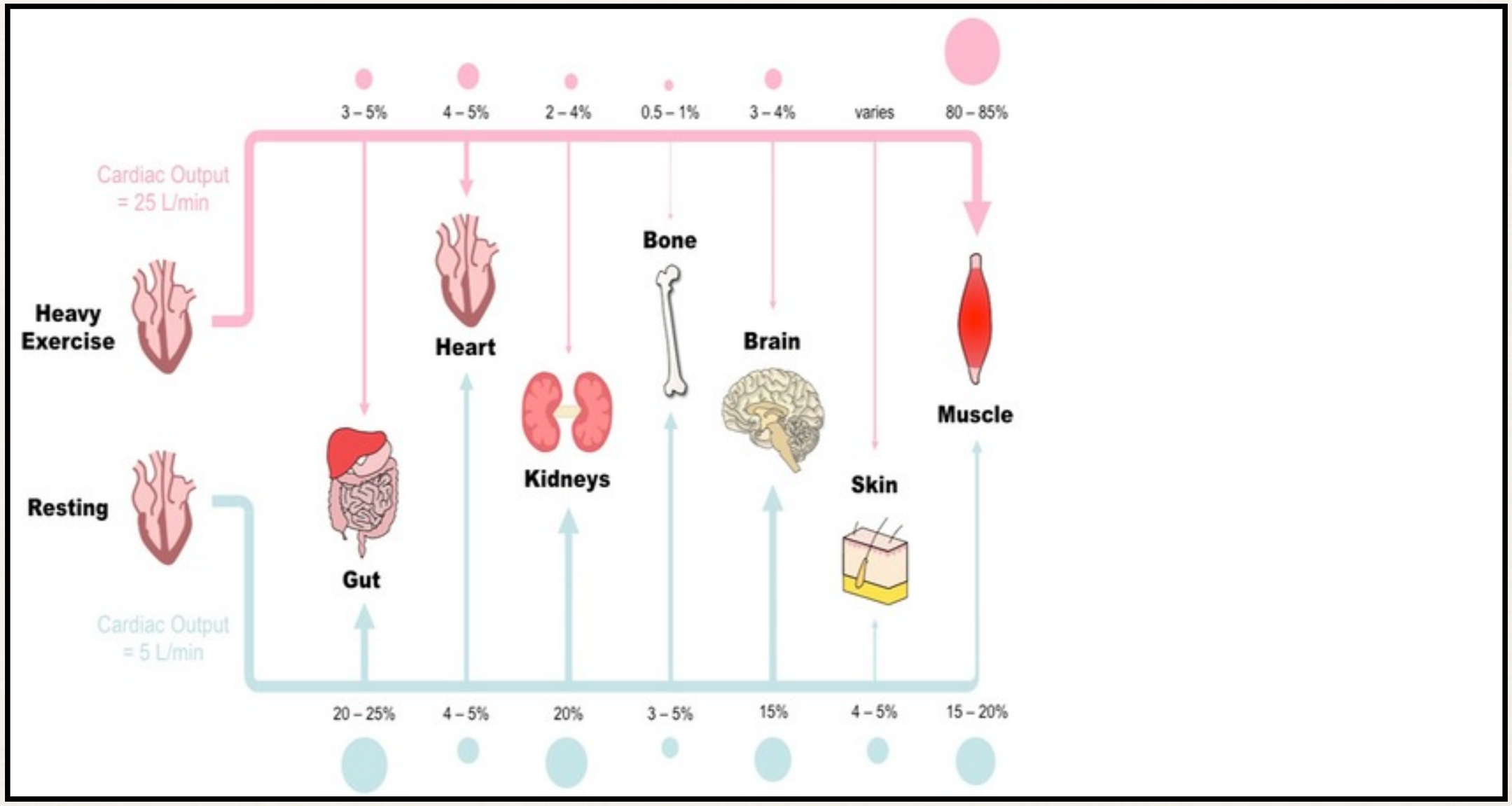
Heart: The Second Cog in the System



Cardiac Output = Heart Rate x Stroke Volume

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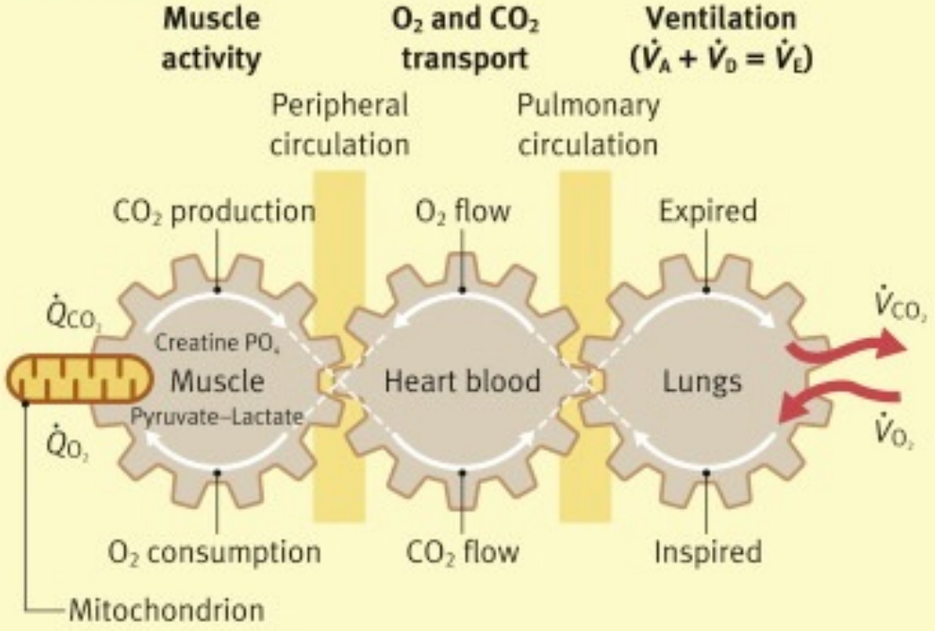
Exercise Physiology 101

The interaction among the pulmonary, cardiovascular and skeletal muscle systems during exercise



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Lungs: The Third Cog in the System

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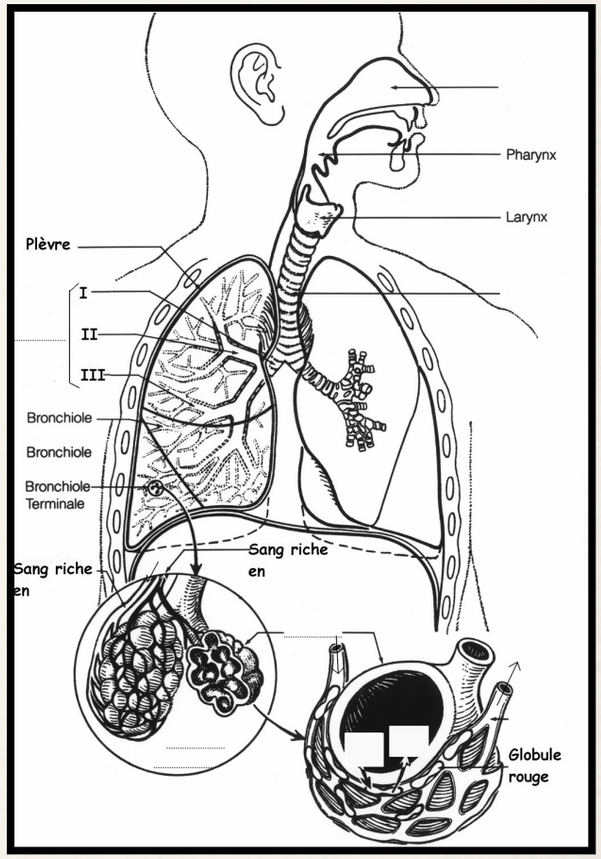
Lungs: The Third Cog in the System

- Ventilation (V_E)
  - the amount of air we expire in one minute
- VO_2
  - the volume of oxygen consumed in one minute
- VCO_2
  - the volume of carbon dioxide produced in one minute



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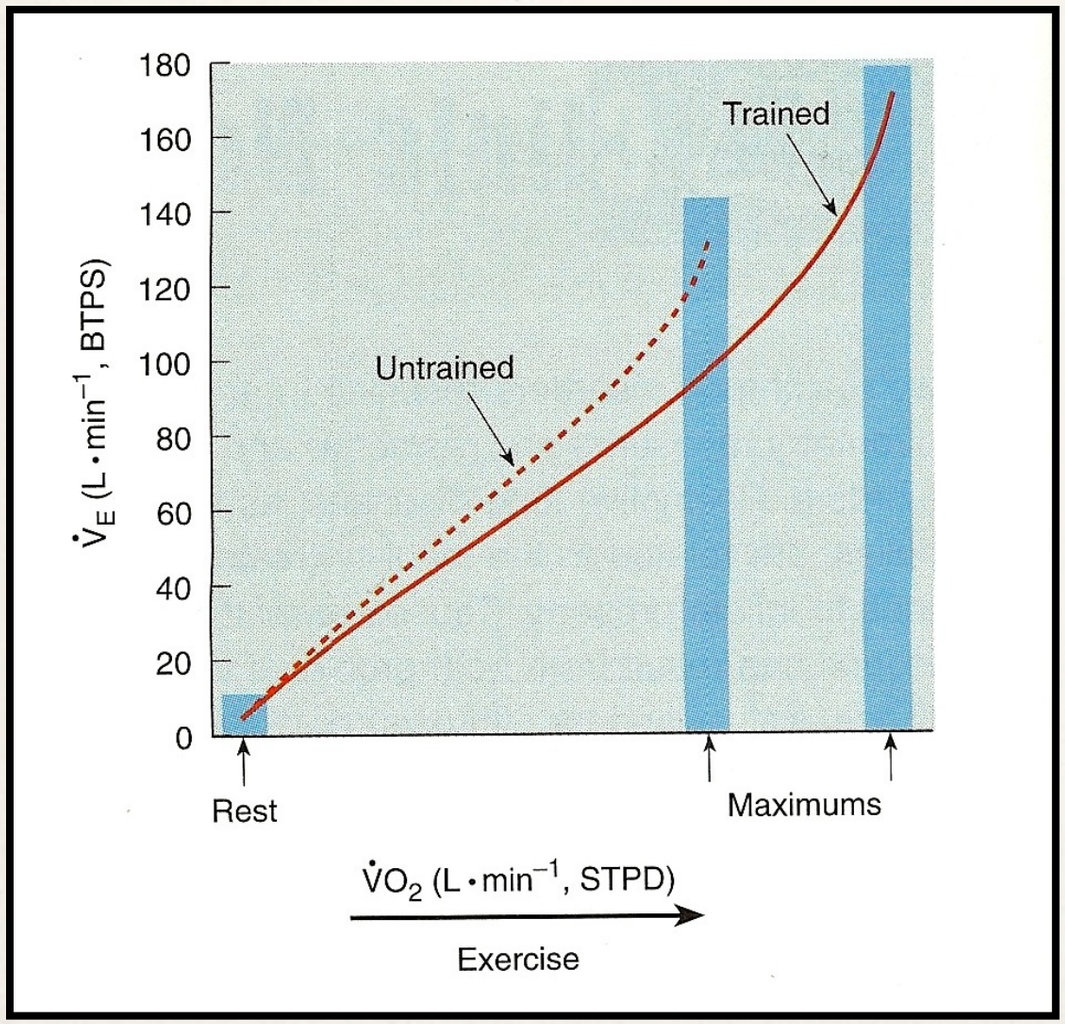
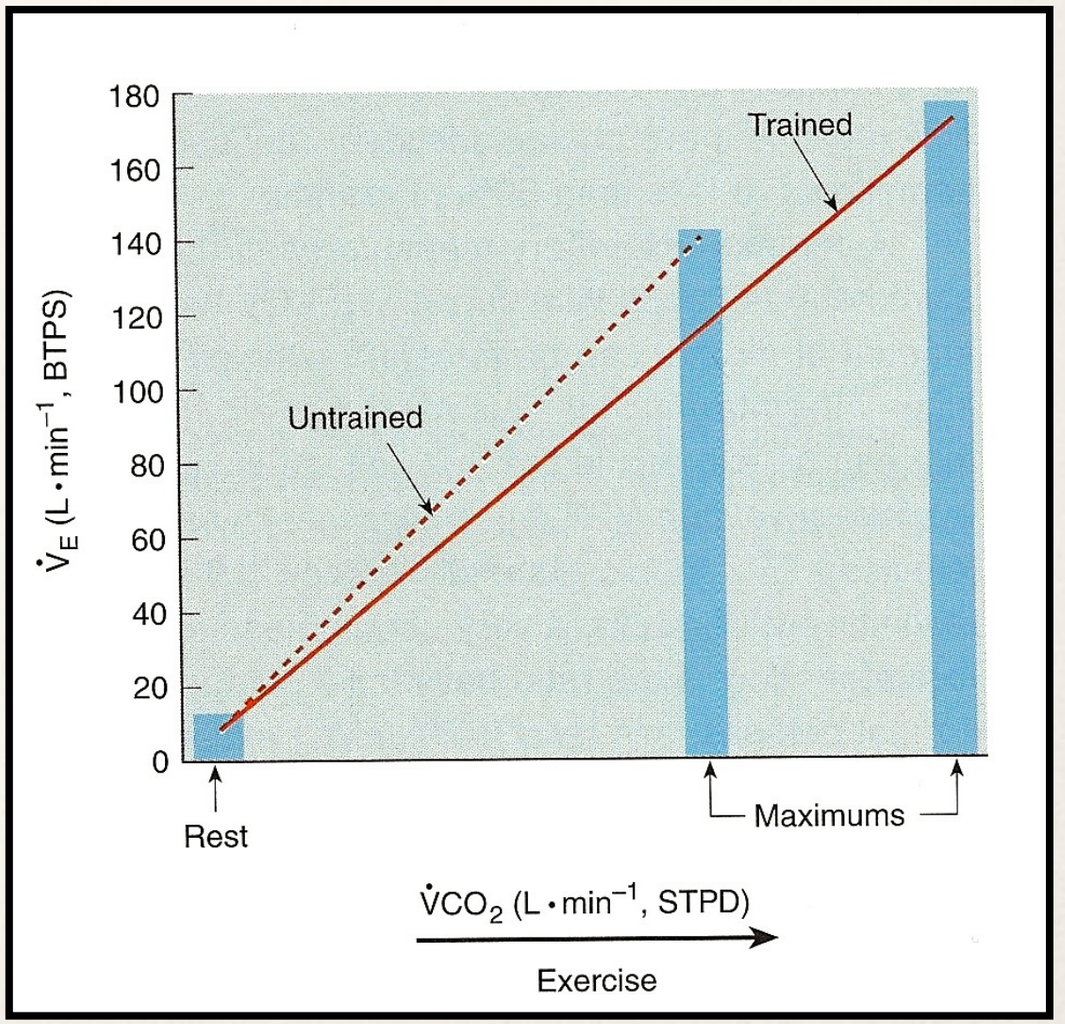
Lungs: The Third Cog in the System





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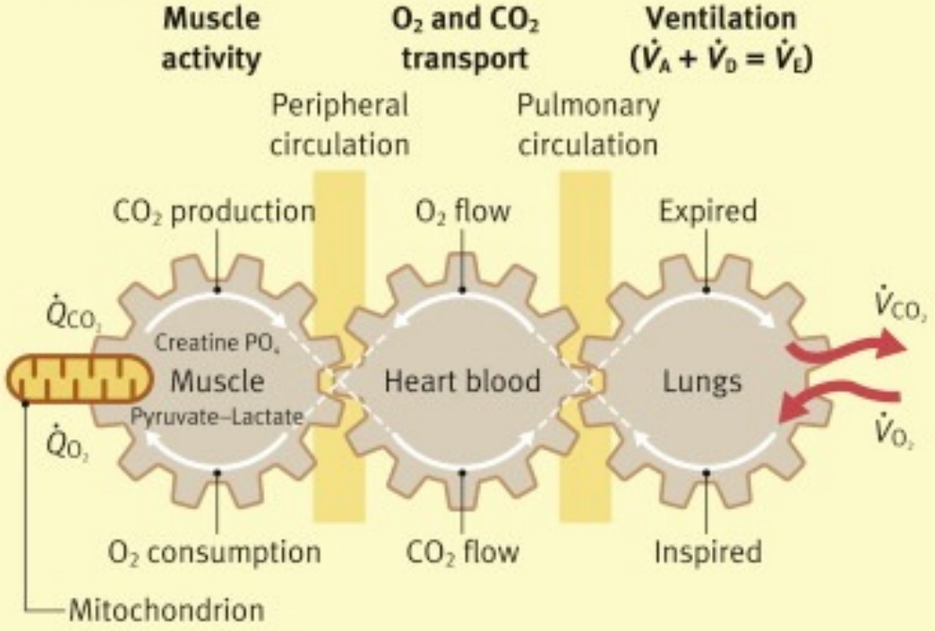
Exercise Physiology 101

The interaction among the pulmonary, cardiovascular and skeletal muscle systems during exercise



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Class task

What are the three energy systems?

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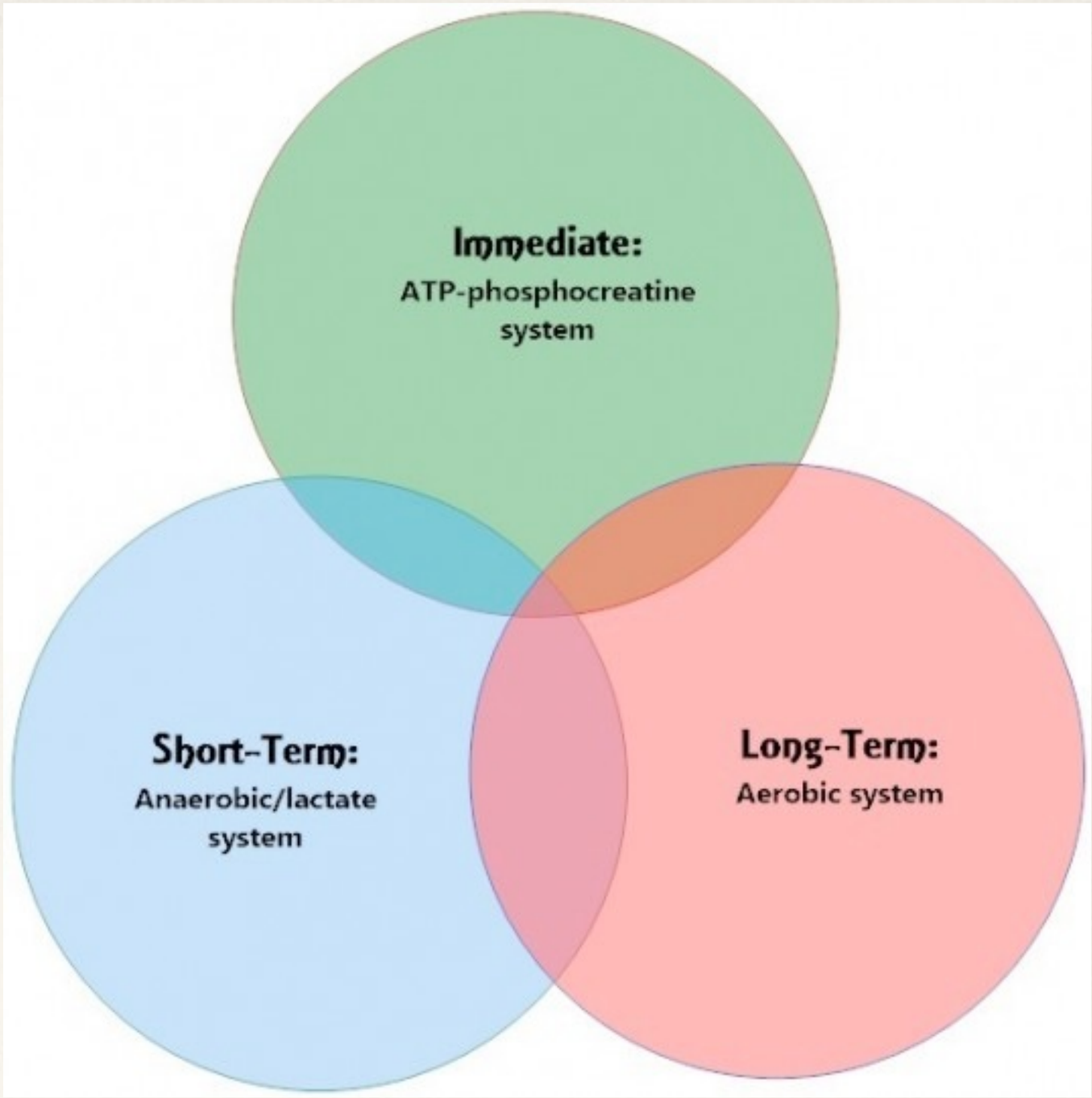

Energy Systems: The Cogs Working Together as a Team

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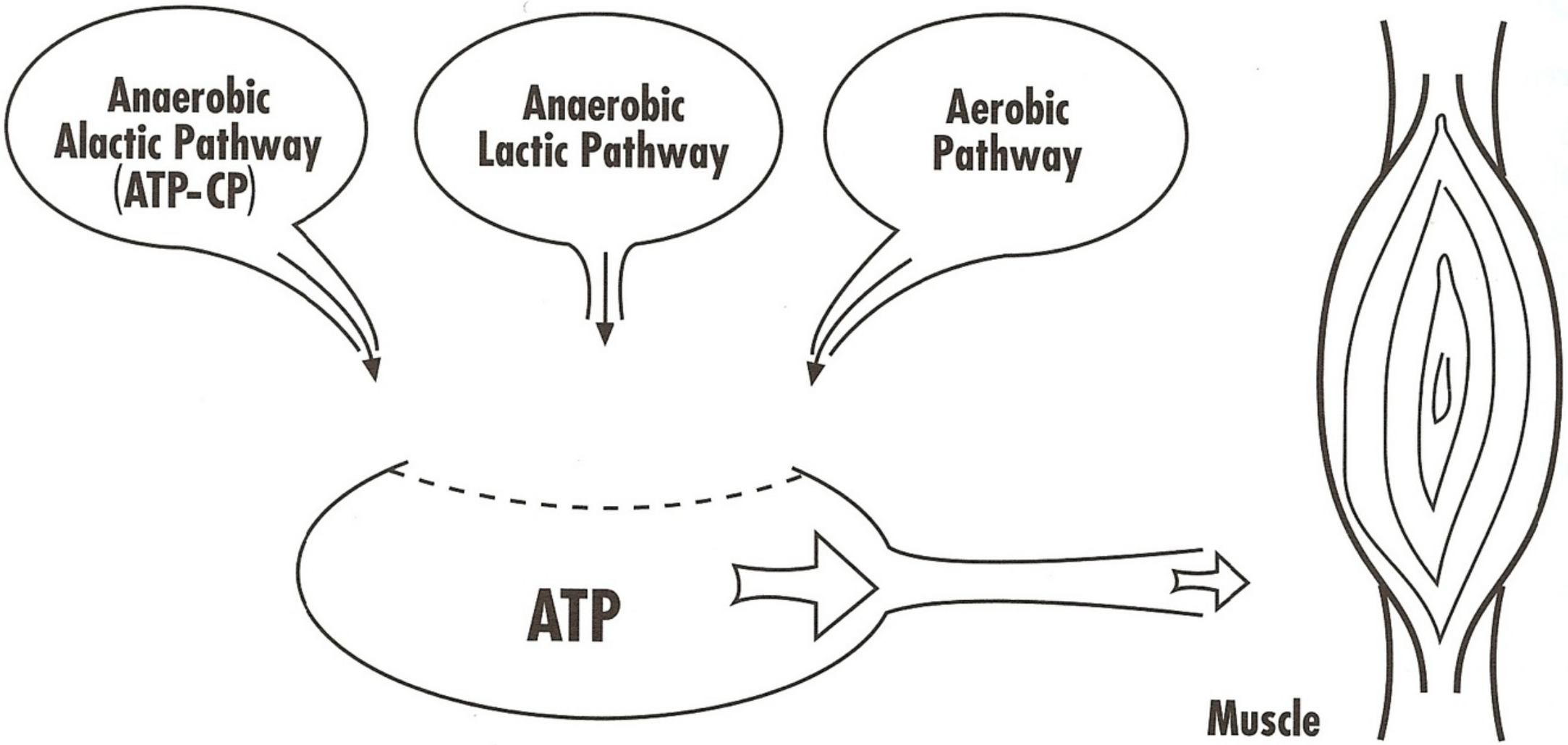
The Three Energy Systems

Figure 10-1: Sources of production of ATP for muscle contraction



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TERMS!
The Three Energy Systems

AFLCA Text	Other #1	Other #2	Other #3
Anaerobic Alactic Pathway (ATP-CP)	ATP-phosphocreatine system	Immediate Energy System (ATP-CP)	Phosphagen System

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TERMS!
The Three Energy Systems

AFLCA Text	Other #1	Other #2	Other #3
Anaerobic Lactic Pathway	Anaerobic/Lactate System	Short Term Energy System (Glycolysis)	Glycogen-Lactic Acid System

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TERMS!
The Three Energy Systems

AFLCA Text	Other #1	Other #2	Other #3
Aerobic Pathway	Aerobic System	Long Term Energy System (Aerobic)	Aerobic Respiration

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TERMS!
The Three Energy Systems

AFLCA Text	Other #1	Other #2	Other #3
Anaerobic Alactic Pathway (ATP-CP)	ATP-phosphocreatine system	Immediate Energy System (ATP-CP)	Phosphagen System
Anaerobic Lactic Pathway	Anaerobic/Lactate System	Short Term Energy System (Glycolysis)	Glycogen-Lactic Acid System
Aerobic Pathway	Aerobic System	Long Term Energy System (Aerobic)	Aerobic Respiration

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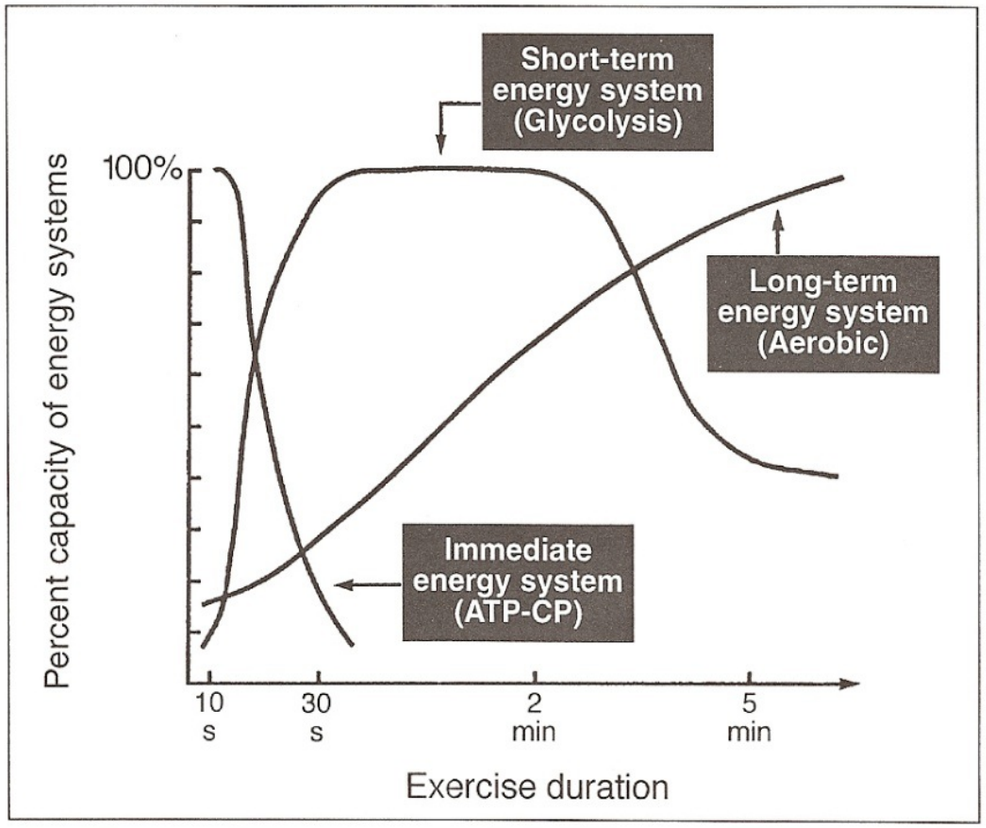
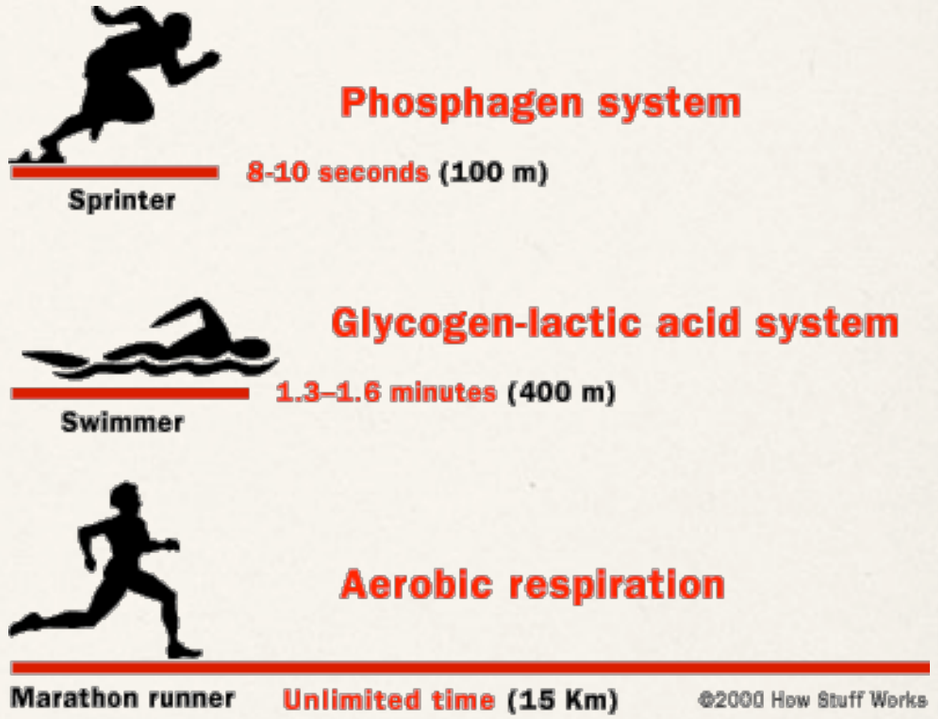
The Three Energy Systems

Figure 3-1: ***The three systems of energy transfer and their percentage contribution to total energy output during all-out exercise of different durations.***



Reference: McArdle, Katch and Katch. (1996). Exercise Physiology. Energy, Nutrition and Human Performance. Williams & Wilkins, Maryland. p. 190.



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The Three Energy Systems

System	Rate of ATP Production	Energy Source	Capacity of System	Major Limitation	Major Use
Anaerobic Alactic Pathway (ATP-CP)	Very rapid rate	stored creatine phosphate (CP), stored ATP in the muscle	Very limited ATP production	Very limited supply of CP	Very high intensity, short duration sprint activities. During high intensity activities of 1-10 seconds.

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The Three Energy Systems

System	Rate of ATP Production	Energy Source	Capacity of System	Major Limitation	Major Use
Anaerobic Lactic Pathway	Rapid rate	Blood glucose, glycogen	Limited ATP production	Lactic acid by product causes rapid fatigue	High intensity, short duration activities. During high intensity activities of 1-3 minutes

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The Three Energy Systems

System	Rate of ATP Production	Energy Source	Capacity of System	Major Limitation	Major Use
Aerobic System	Slow rate	Blood glucose, glycogen, fatty acids	Unlimited ATP production	Relatively slow rate of oxygen delivery to cells	Moderate intensity, longer duration. During moderate to high intensity activities longer than 3 minutes. Fatty acid oxidation dominates after ~20 minutes of exercise.

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The Three Energy Systems

System	Rate of ATP Production	Energy Source	Capacity of System	Major Limitation	Major Use
Anaerobic Alactic Pathway (ATP-CP)	Very rapid rate	stored creatine phosphate (CP), stored ATP in the muscle	Very limited ATP production	Very limited supply of CP	Very high intensity, short duration sprint activities. During high intensity activities of 1-10 seconds.
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Aerobic System	Slow rate	Blood glucose, glycogen, fatty acids	Unlimited ATP production	Relatively slow rate of oxygen delivery to cells	Moderate intensity, longer duration. During moderate to high intensity activities longer than 3 minutes. Fatty acid oxidation dominates after ~20 minutes of exercise.

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Training Continuum

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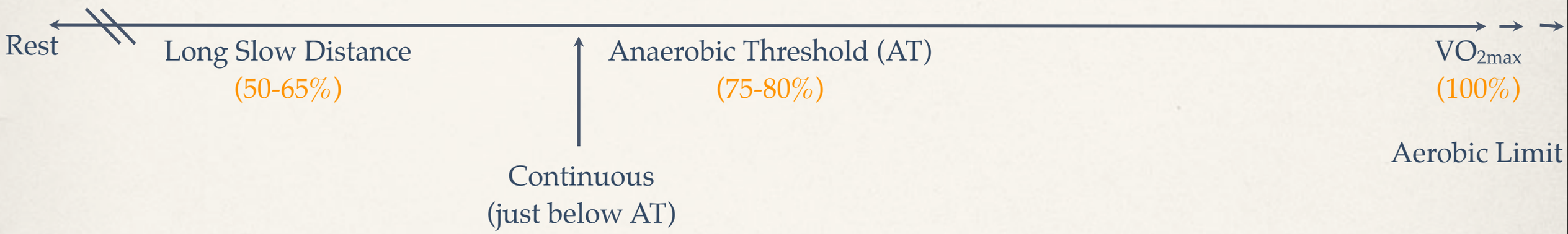
Training Continuum



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Terms

- Long Slow Distance (LSD)
- Anaerobic/Lactic Threshold
  - exercise intensity at which lactic acid starts to accumulate in the blood stream and CO_2 production begins to increase non-linearly
  - lactate removal fails to keep up with the rate of lactate production causing increased in CO_2 production
- VO_{2max}
  - the maximum volume of oxygen consumed in one minute

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Terms

- Spin out (RPE = 2-3)
  - resistance is low and participants can cycle at their leisure. Good for breaks and cool-downs.
- Steady state or Time Trial (RPE = 5-6); just below race pace
  - A resistance that can be maintain for a long duration such that you were cycling a long distance (i.e., road trip to Calgary). Maintain revolutions to 20-22 (80-88 RPM).

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Terms

- Sprints (RPE = 7-9)
  - Hold a resistance slightly above Time Trial but not as high as a Hill. Increase revolutions to a sprint pace. Make sure that there is enough resistance so that the legs and body are not out of control (i.e., back side jumping up and down on the saddle). Revolutions may increase to 100+ RPM.

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Terms

- Hills (RPE = 7-9)
  - Add resistance to simulate hill; Cadence slows to ~ 60 RPM
  - Seated or standing
- Speed/Downhill (RPE = 6-7)
  - Reduce resistance; increase revolutions to 90-100 RPM
  - Fast legs, staying in control, as if you were going down a hill

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Terms

- Power (RPE = 8-10)
  - Equals increased speed (RPM) with increased resistance (tension)
  - "Break away from the pack"
  - Fine line between too much speed or too much resistance
  - Short in duration (< 60 seconds each)
  - Seated Power/Standing Power

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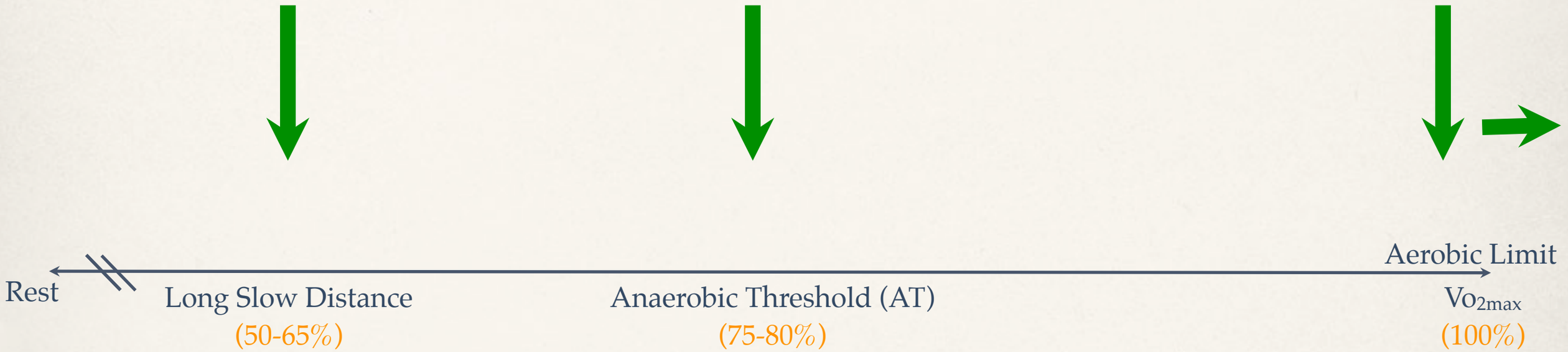
Training Continuum



Aerobic Energy System ⟷ Anaerobic Lactic Energy System

Anaerobic Alactic Energy System

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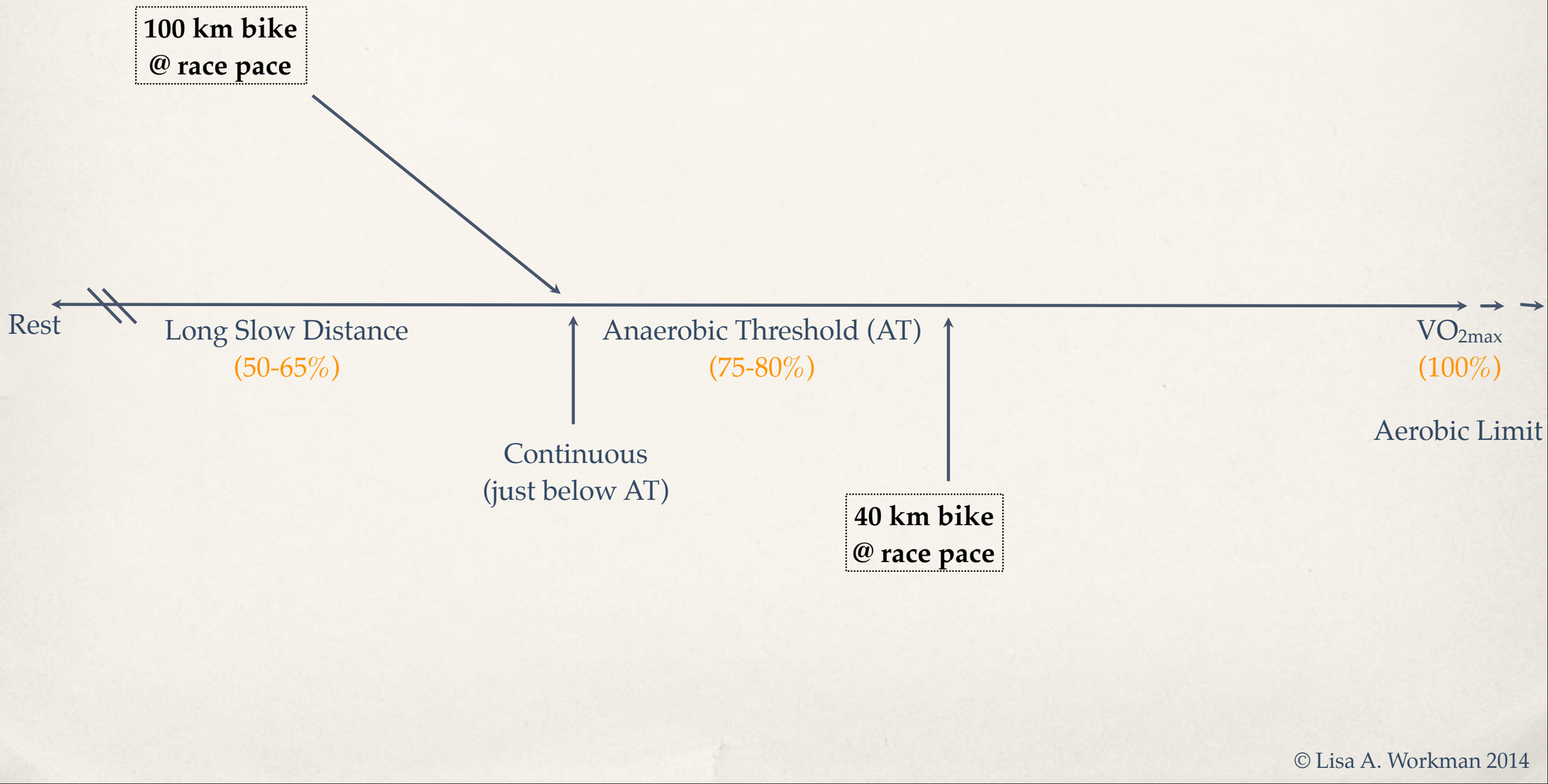
Training Continuum



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Training Continuum

100 km bike @ race pace

Rest

Long Slow Distance (50-65%)

Continuous (just below AT)

Anaerobic Threshold (AT) (75-80%)

40 km bike @ race pace

VO_{2max} (100%)

Aerobic Limit

Aerobic Intervals
Work: below race pace (training pace)
Rest: short

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Aerobic System: LongTerm

- ***Aerobic Intervals***
  - Aerobic energy system
  - Blood Glucose, Glycogen, Fatty Acids
  - 1:1 Work-to-Rest Ratio
  - 1:0.5 Work-to-Rest Ratio
  - *Example:* 3 min flat time trial with 1.5 min spin-out recovery

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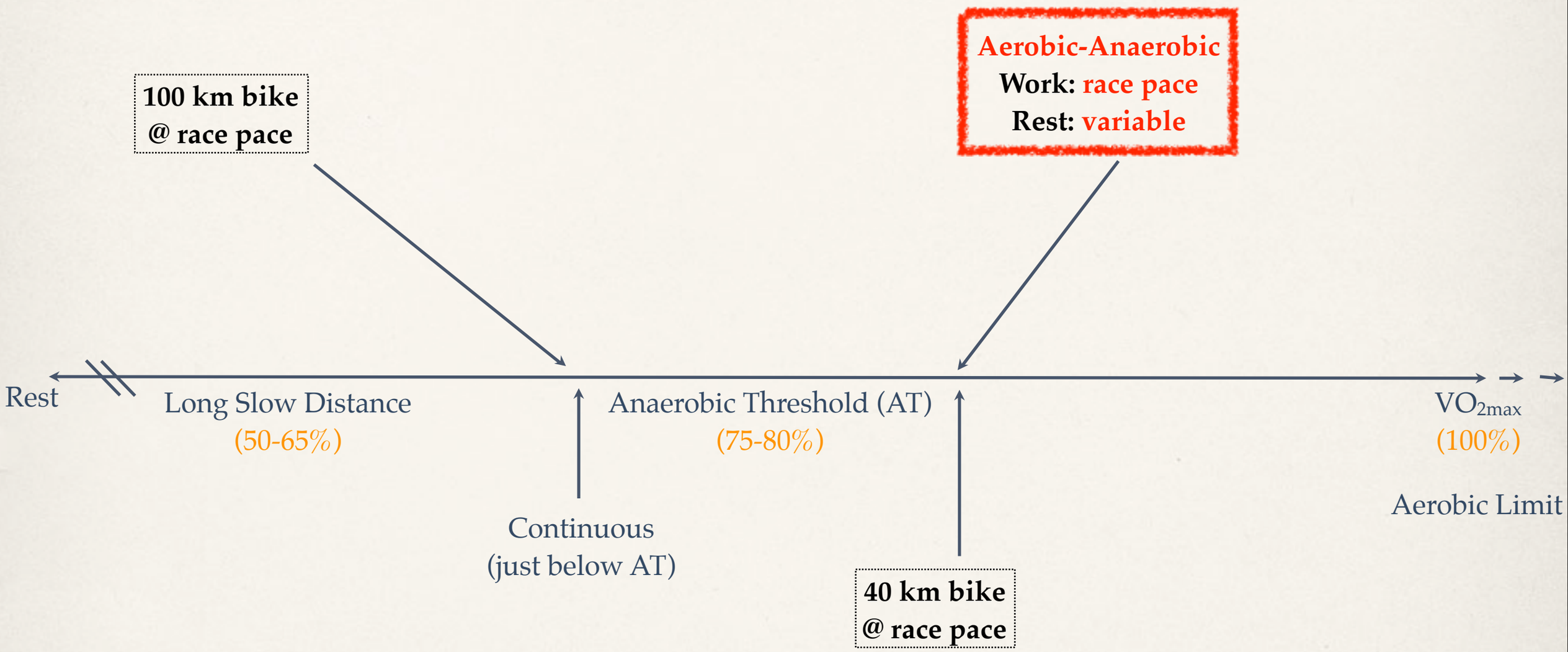
Training Continuum



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Aerobic + Anaerobic Systems

- ***Combination of Aerobic and Anaerobic Capacity/Lactic Systems***
- Moving from aerobic to anaerobic back to aerobic
- 1:2 Work-to-Rest Ratio
- *Example:* 1 minute time trial with 30s sprint; return back to time trial with each sprint interval

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Training Continuum

100 km bike
@ race pace

AT intervals
Continuous
Work: +/- 10%
Rest:

Rest

Long Slow Distance
(50-65%)

Continuous
(just below AT)

Anaerobic Threshold (AT)
(75-80%)

40 km bike
@ race pace

VO_{2max}
(100%)

Aerobic Limit

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Anaerobic System: ShortTerm

- ***Anaerobic Threshold Intervals***

- Anaerobic Capacity; Anaerobic Lactic

- Glycolysis/Glycogenolysis

- 1:2 Work-to-Rest Ratio

- *Example:* 30s Seated Power with 1 min spin-out recovery

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Training Continuum

100 km bike @ race pace

Rest

Long Slow Distance (50-65%)

Continuous (just below AT)

Anaerobic Threshold (AT) (75-80%)

40 km bike @ race pace

VO_{2max} (100%)

Aerobic Limit

Anaerobic intervals
Work: ~120% of race pace
Rest: variable

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Anaerobic System: Immediate

- ***Anaerobic Intervals***

- Anaerobic Power; Anaerobic Alactic

- ATP-CP

- 1:3 Work-to-Rest Ratio

- *Example:* 15s Sprint with 45s spin-out recovery

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Training Continuum

100 km bike @ race pace

VO_{2max} Intervals
Work: 90-100%
Rest: 30-40%

Rest

Long Slow Distance
(50-65%)

Continuous
(just below AT)

Anaerobic Threshold (AT)
(75-80%)

40 km bike @ race pace

VO_{2max}
(100%)

Aerobic Limit

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Anaerobic System: Immediate

- ***VO_{2max} Intervals***
  - Anaerobic Power; Anaerobic Alactic
  - ATP-CP
  - 1:2 Work-to-Rest Ratio
  - 1:3 Work-to-Rest Ratio
  - *Example:* 30s at predetermined VO_{2max} with 60s recovery

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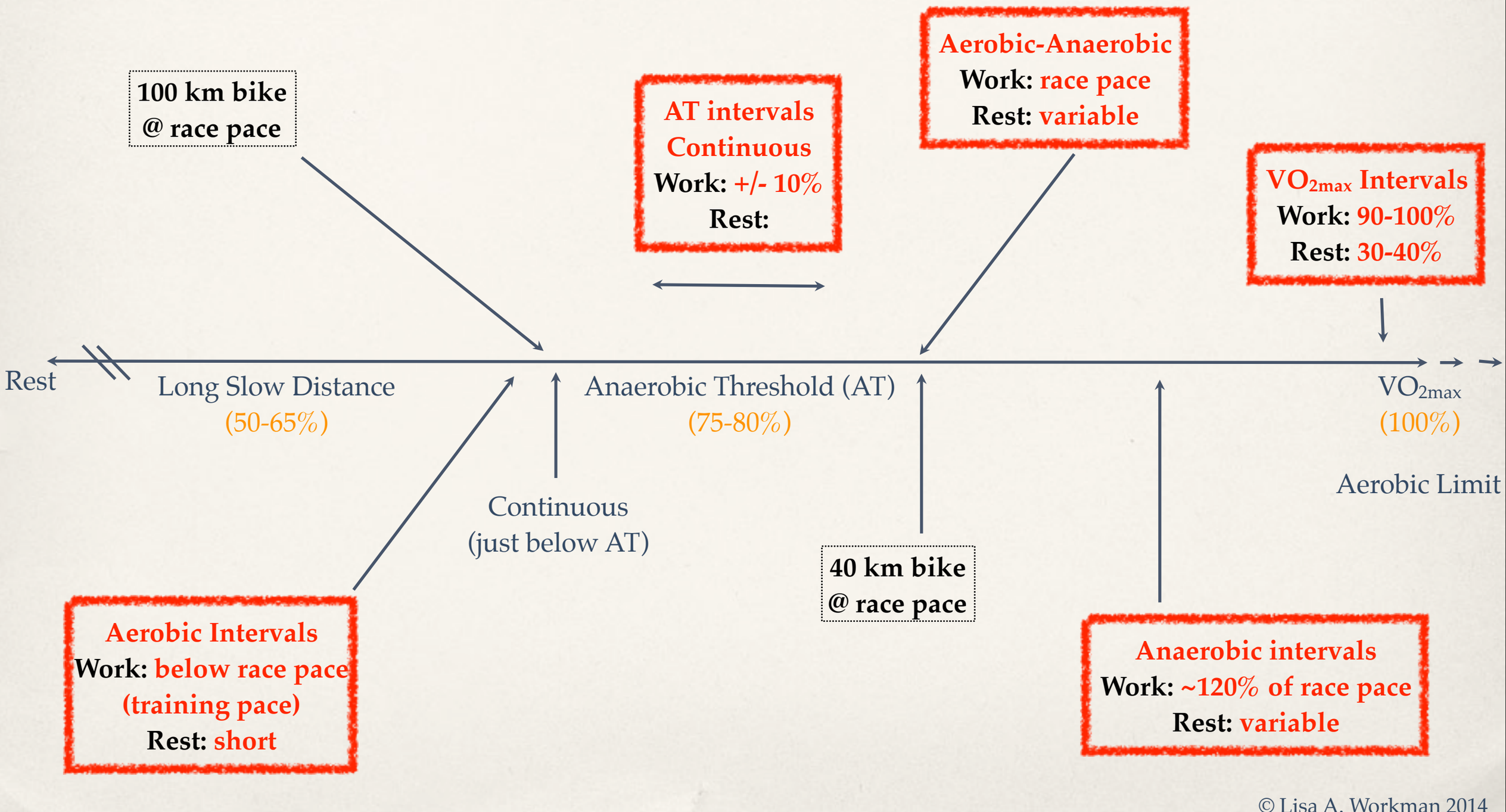
Training Continuum



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Studies have shown that riding a bicycle everyday makes you more awesome than the general population.

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Drills and Skills

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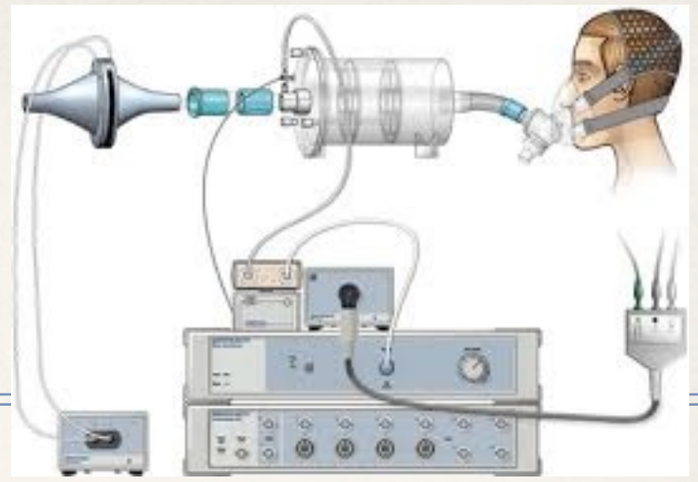
Drills and Skills



Estimating VO_{2max} intensity with Graded Exercise Test

- Use consistent cadence (80-90 rpm) and slowly increase resistance
- Each bike will vary with how much resistance needs to be added
- Use increments (with tension knobs), levels (with levers) and/or wattage if your computer console provides
- Ensure your starting resistance is clear and emphasize to participants to visually mark where their final VO_{2max} is (if wattage not available)

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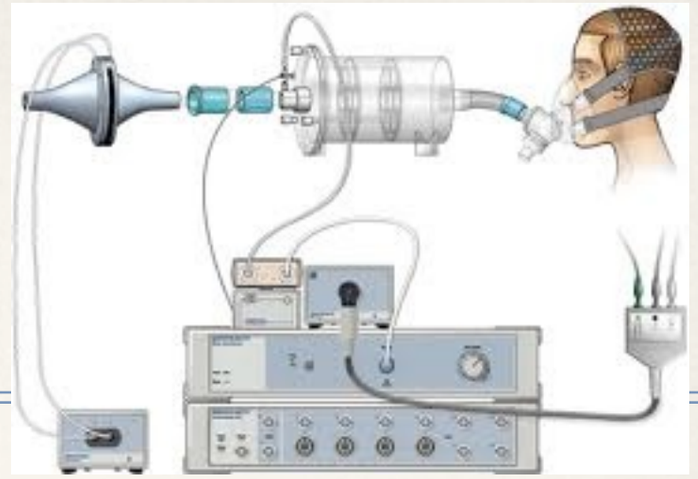
Drills and Skills



Estimating VO_{2max} intensity with Graded Exercise Test

Stage	Resistance	Duration
I	Time Trial	1 minute
II	Add increment (gear/turn of tension knob)	1 minute
III	Add increment (gear/turn of tension knob)	1 minute
IV	Add increment (gear/turn of tension knob)	1 minute
V	Add increment (gear/turn of tension knob)	30 seconds
VI	Add increment (gear/turn of tension knob)	30 seconds
VII	Add increment (gear/turn of tension knob)	30 seconds
VIII	Add increment (gear/turn of tension knob)	30 seconds

The entire drill is in the seated position. If participants need to stand, they have likely found their VO_{2max} resistance and cadence.

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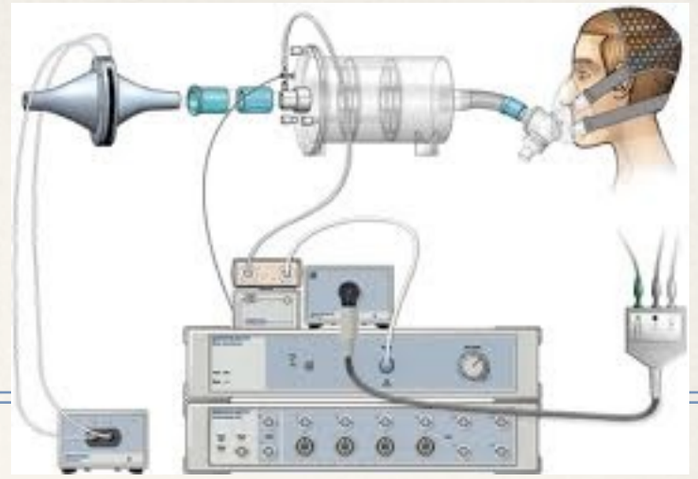
Drills and Skills



VO_{2Max} Intervals

- Work to Rest Ratio - 1:2 or 1:3
  - 15s : 45s at VO_{2max} gear/tension (1:3)
    - 5 times (5 minutes)
  - 30s : 60s at VO_{2max} gear/tension (1:2)
    - 5 times (8 minutes)

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Drills and Skills

Climb to New Heights Drill Aerobic Intervals

- Work to Rest Ratio - 1:0.5

- Long duration drill with emphasis on the aerobic energy system

- Using the Hill cards from the Indoor Cycling Toolbox, each participant is given a hill card and joins a "team" consisting of the participants sitting in their row (horizontal row)

- Depending on the number of participants will dictate the duration of each hill card

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Climb to New Heights: Hill Cards Line Drill

Number of Participants in Row	Time for each Card*	Total Work (1)	Rest (0.5)
1	30s	30s	15s
2	30s	60s	30s
3	30s	90s	45s
4	30s	120s	60s
5	30s	150s	75s
6	30s	180s	90s
7	30s	210s	105s

*Large group of participants in class

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Climb to New Heights: Hill Cards Line Drill

Number of Participants in Row	Time for each Card*	Total Work (1)	Rest (0.5)
1	60s	60s	30s
2	60s	120s	60s
3	60s	180s	90s
4	60s	240s	120s
5	60s	300s	150s
6	60s	360s	180s
7	60s	420s	210s

*Small group of participants in class

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Time Trial Pace +1 (Race Pace) Interval

- Aerobic Intervals
- Work to Rest Ratio - 1:1
- Below anaerobic threshold
  - Time Trial Pace +1 increment/gear (2 min) : Spin Out (2 min)
  - Repeat 2-6 times

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Pace Line

- Anaerobic Threshold intervals

- Work to Rest Ratio - 1:3

- Group of 4 or more (double up position if needed) on a team

- Each member of the team completes 20 seconds of each drill type as in a pace line

- Each team member completes each drill type three times (i.e., repeat the pace line x3)

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Pace Line

Position #1	Seated Power	Standing Power
Position #2	Time Trial	
Position #3	Time Trial	
Position #4	Spin Out	

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Drills and Skills

Flat to a Climb to a Breakaway from the Pack!

- Aerobic + Anaerobic Intervals
  - Work to Rest ratio - 1:2
    - 1 min Time trial + 30s seated hill with last 15s seated power out to the top - Spin out/down hill 30 s - Repeat
    - 1 min Time trial + 30s standing hill with last 15s standing power out to the to - Spin out/down hill 30 s - Repeat

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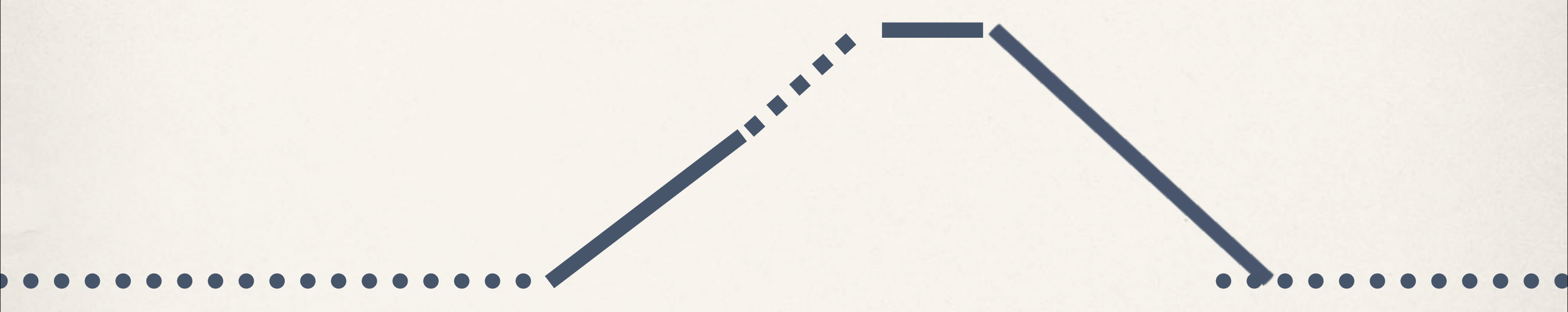
Drills and Skills

Flat to a Climb to a Breakaway from the Pack!



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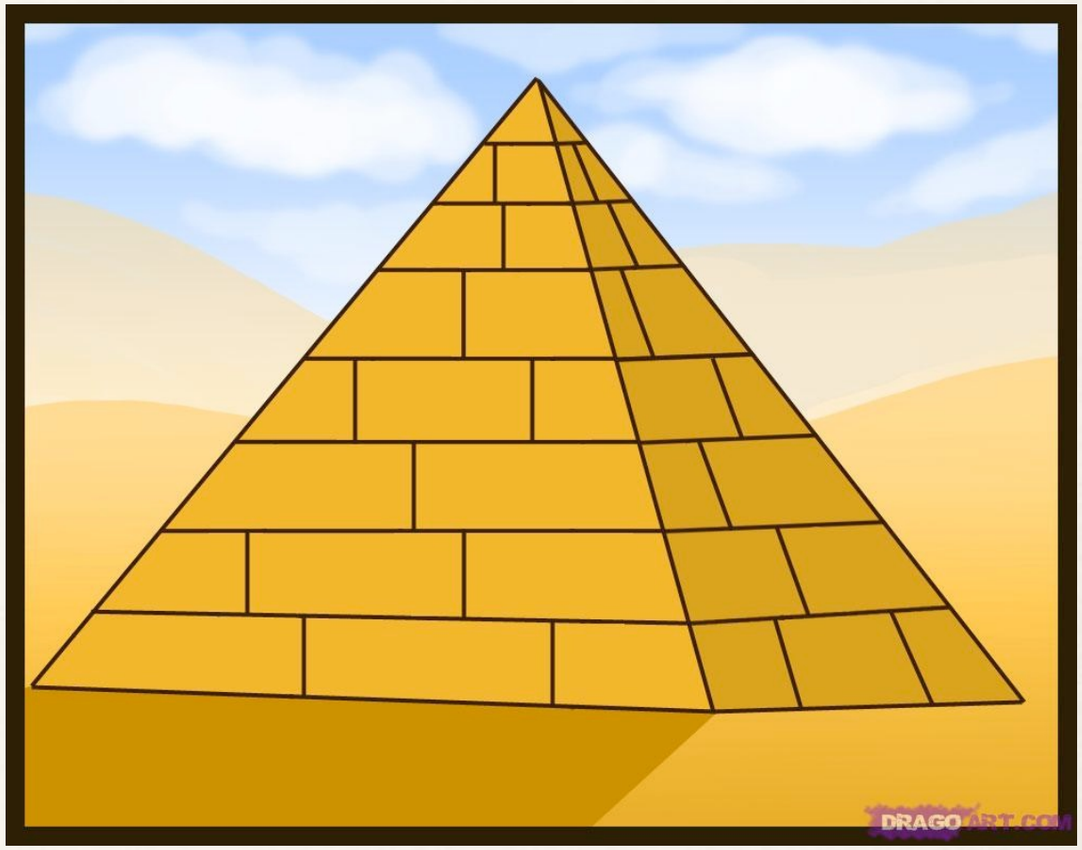
Drills and Skills



Sprint Pyramid

- Anaerobic Intervals
- Work to Rest Ratio - 1:3

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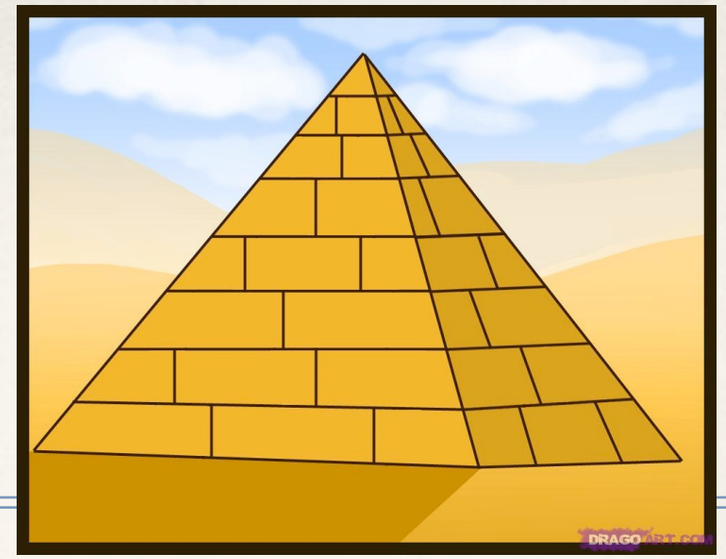
Drills and Skills



Sprint Pyramid

Work	Rest	Work	Rest
5s	15s	25s	75s
10s	30s	20s	60s
15s	45s	15s	45s
20s	60s	10s	30s
25s	75s	5s	15s
30s	90s		

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Drills and Skills

Power Up Partner Drill

- Anaerobic Intervals
- Work to Rest Ratio - 1:2 and 1:3
- Indoor Cycling Toolbox: One card for each participant
- Pick a partner - ideally, someone beside or on a close bike

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Drills and Skills

Power Up Partner Drill (continued)

- Both partners start at a steady state/flat road
- Each partner will alternate calling their card which the other partner will complete for as long as he/she can (ideally, 15-45 s)
- Partners will switch
- Provide 3-5 minutes for the partners to alternate at least 4-5 times

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Drills and Skills

Applause!

- Anaerobic Threshold Intervals
- Work to Rest Ratio - ~1:2
    - Lady Gaga!

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Drills and Skills

Song Time	Duration	Drill
0 - 00:55	55s	Lead in time trial
00:55 - 01:22	27s	Seated Power
01:22 - 02:03	41s	Spin out - time trial
02:03 - 02:30	27s	Seated Power
02:30 - 02:58	28s	Spin out - time trial
02:58 - 03:26	28s	Seated Power

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Acknowledgements

Photo Credit: woodleywonderworks

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Acknowledgements

- Mentor – Kelly Mackenzie-Rife

- Editor – Cameron Brown

- Images – Google and Flickr

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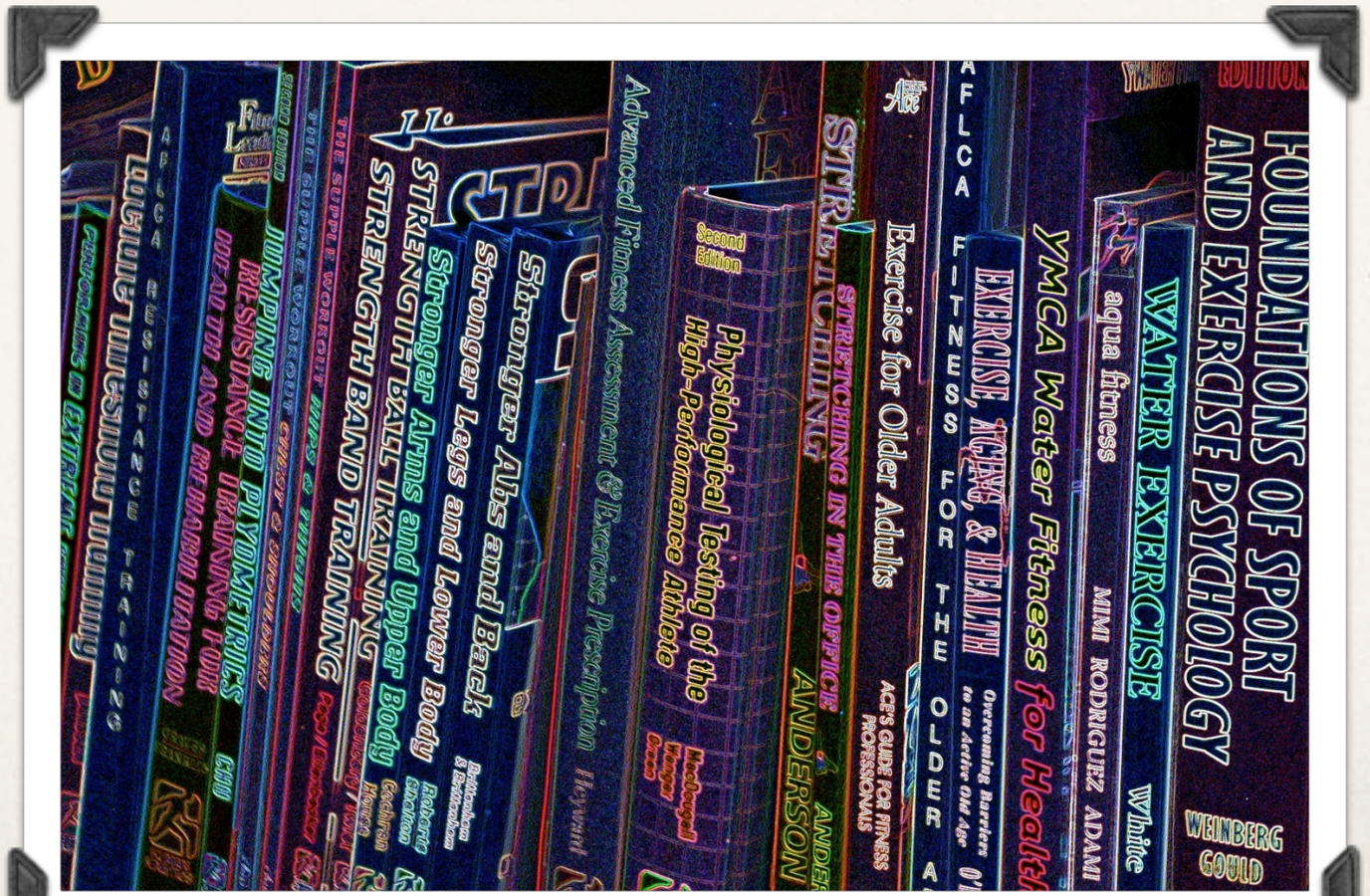
References and Resources



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Resources

http://www.lisaworkman.com/cycle-drills-blog.html

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