



Exercise Physiology 101

INTRODUCTION TO ENERGY SYSTEMS AND TRAINING ZONES

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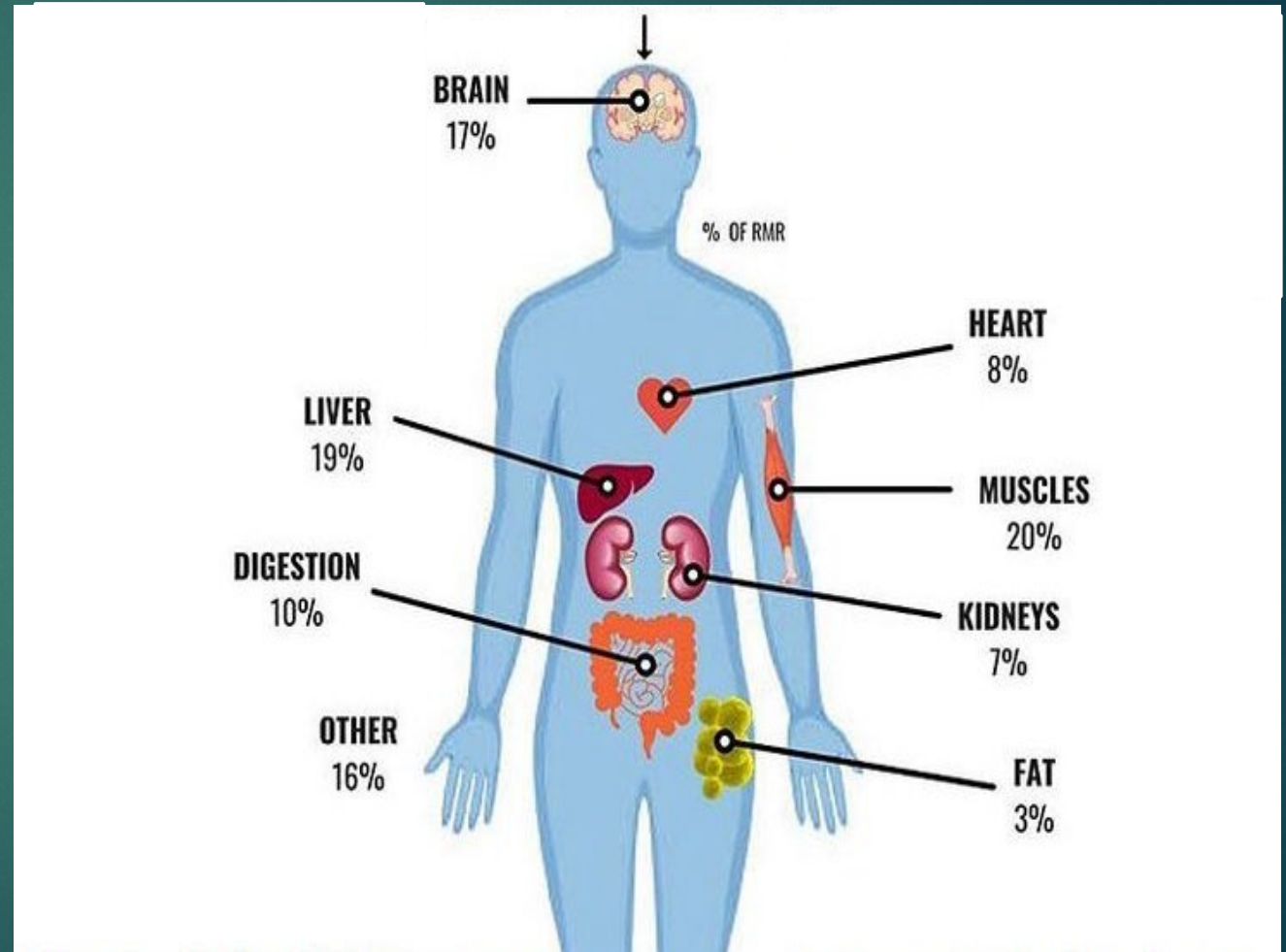
OUTLINE



- ▶ Energy Systems
- ▶ Training Zones
 - ▶ Monitoring Training Intensity
 - ▶ Why is this so important?
 - ▶ Training Effects
 - ▶ Training Quality

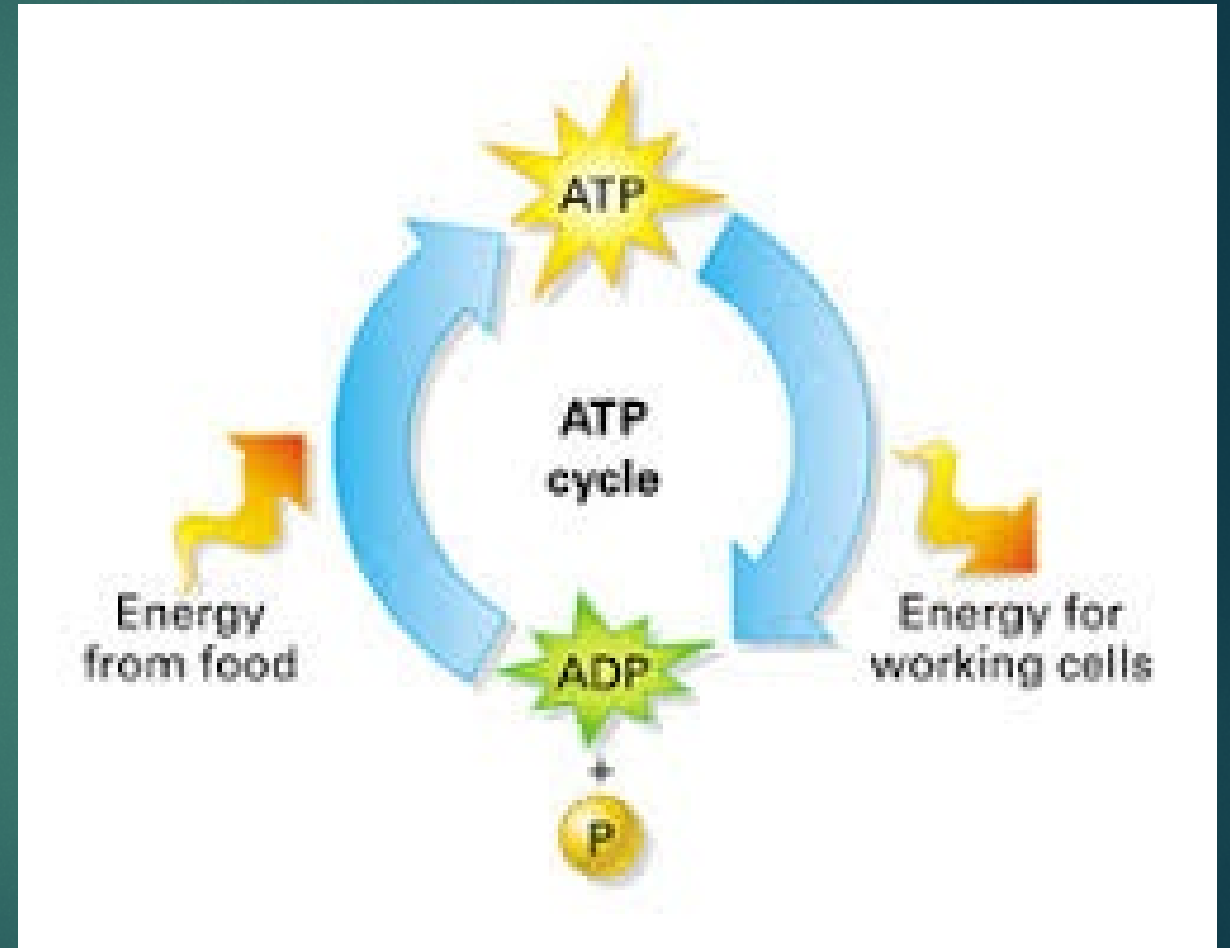
ENERGY IS NEEDED FOR:

- ▶ Maintaining body temperature
- ▶ Metabolic activities
- ▶ Physical movement



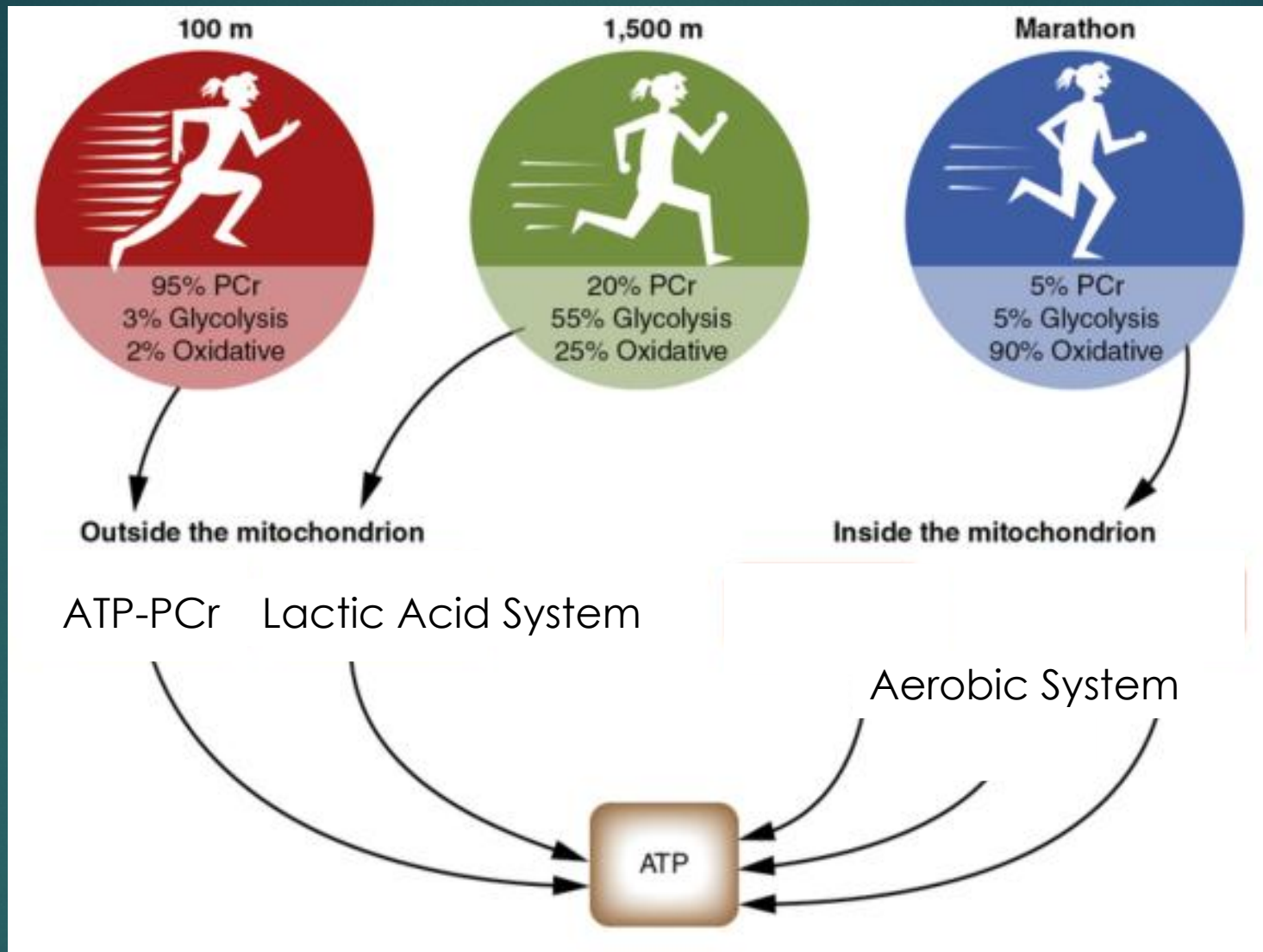
ENERGY IS PROVIDED BY:

- ▶ ATP (adenosine triphosphate)
 - ▶ Stored in the muscles (storage is limited)
 - ▶ Any intense physical movement longer than a few seconds requires more ATP to be produced




ENERGY SYSTEMS

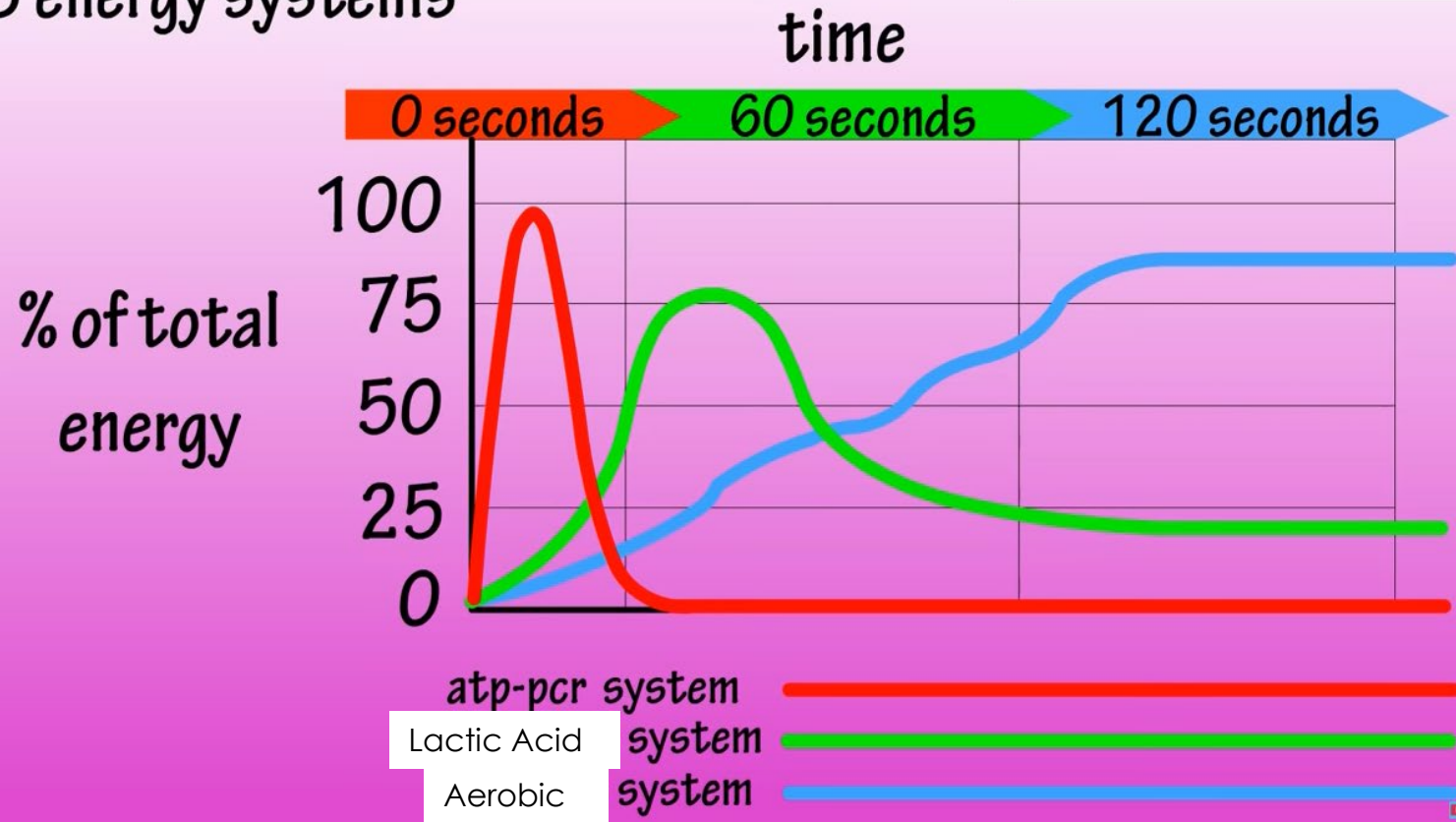
- ▶ Immediate Energy
 - ▶ ATP-PCr System
 - ▶ 100-m dash, 25m swim, lifting a heavy weight
 - ▶ Energy provided almost exclusively from intramuscular high-energy phosphates or phosphagens, ATP and PCr
- ▶ Short-Term Energy
 - ▶ The Lactic Acid System
 - ▶ For more continuous or longer duration strenuous exercise
 - ▶ The energy to produce ATP at these intensities derives mainly from stored muscle glycogen (from carbohydrates)
- ▶ Long-Term Energy
 - ▶ The Aerobic System
 - ▶ Provides most of the energy transfer during steady state exercise and when intense exercise lasts longer than several minutes (uses carbohydrates, fats and if needed proteins)



Adapted From: <https://canada.humankinetics.com/blogs/excerpt/energy-systems>

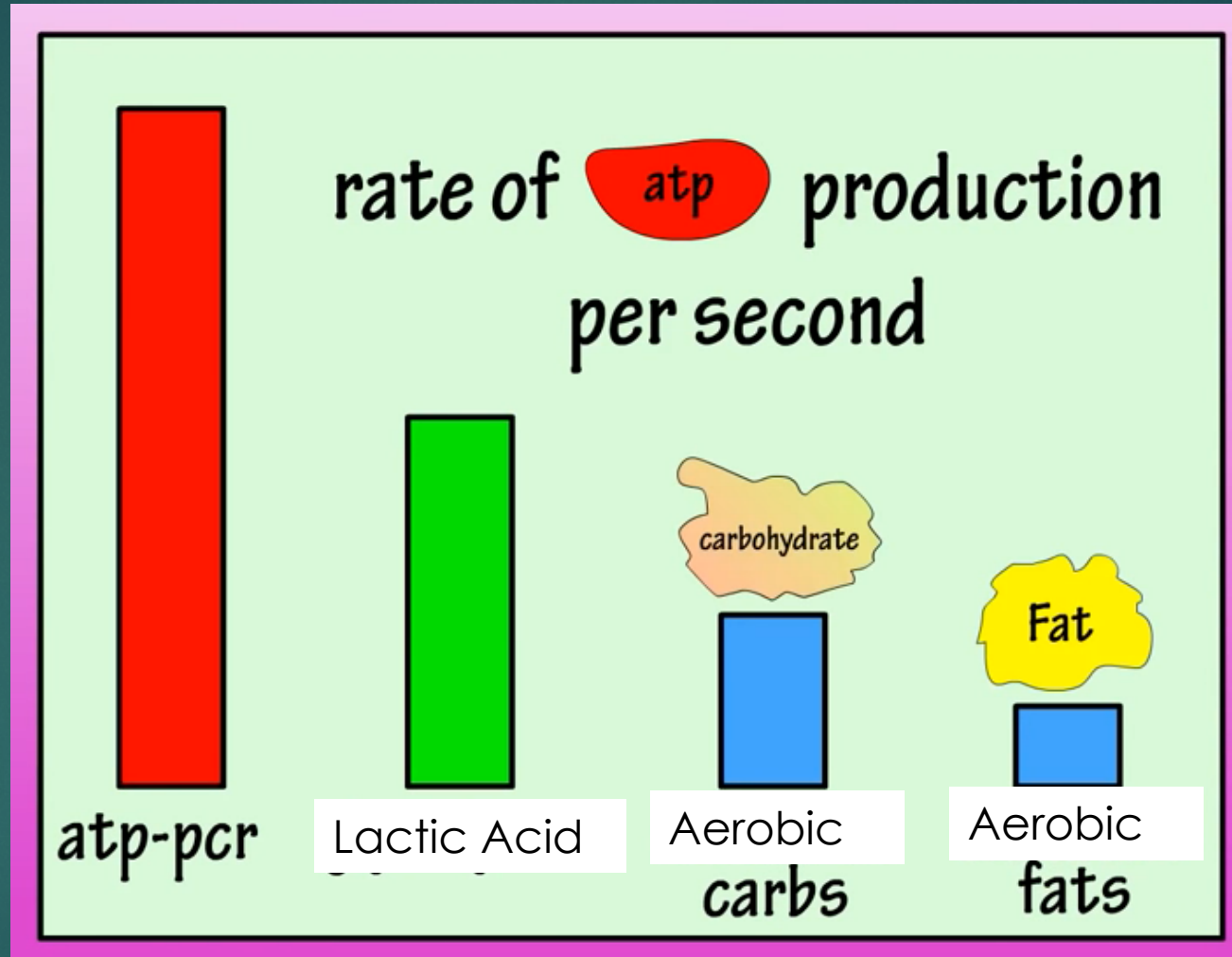
3 energy systems

Suggested: Why do we get fat - Why do we gain weight as we get ol... 



Adapted From: <https://www.youtube.com/watch?v=dWe8vtzTW-4>

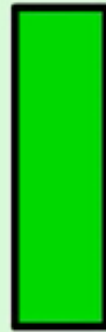
*Energy from exercise does not result from activation of a series of energy systems that “switch on” and “switch off” but rather a smooth blending, with considerable overlap of one mode of energy transfer to another



Adapted From: <https://www.youtube.com/watch?v=dWe8vtzW-4>

rate of **atp** production

Aerobic - carbohydrates

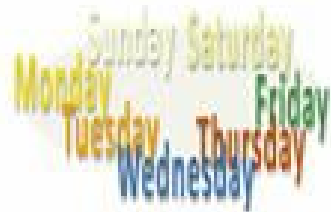


untrained medium trained well trained

Adapted From: <https://www.youtube.com/watch?v=dWe8vtzW-4>



F.I.T.T Principle



Frequency



Intensity



Time



Type

TRAINING ZONES

- ▶ Determined based on the relative contribution of the aerobic and anaerobic energy processes
- ▶ Heart rate-based training zone distribution
- ▶ Determined by:
 - ▶ Percentage of age-predicted heart rate maximum
 - ▶ $220 - \text{age}$
 - ▶ Percentage of heart rate maximum
 - ▶ Percentage of heart rate reserve
 - ▶ Incremental Exercise Testing
 - ▶ Ventilatory threshold measurement
 - ▶ Blood lactate threshold measurement

Figure 4.7: Approximate BL_a, RPE, Speed and HR Targets for T2T Athletes

T2T Training Zone (for YTP)	T2T Training Zone (detailed)	HR Range (% HR _{max})*	% of MAS	RPE Range (Borg Scale)	Blood Lactate ¹
ZONE 1-2	Endurance	~ 60 – 80%	50-75%	7 – 12	1.0
ZONE 3	Anaerobic Threshold (AnT)	~ 80 – 90%	~80-85%	13 – 15	~ 2.5
ZONE 4	Race pace	~ 85 – 95%	~85-95%	15 – 17	~ 4.5
	Maximal Aerobic Speed (MAS)	95 – 100%	100%	17 – 19	~ 5.0 - 8.0
SPRINT	Sprinting	N/A	~110-130%	20	<2.5
SPEED	Pure Speed	N/A	~130%	20	N/A

WHAT IMPACTS ENDURANCE PERFORMANCE?

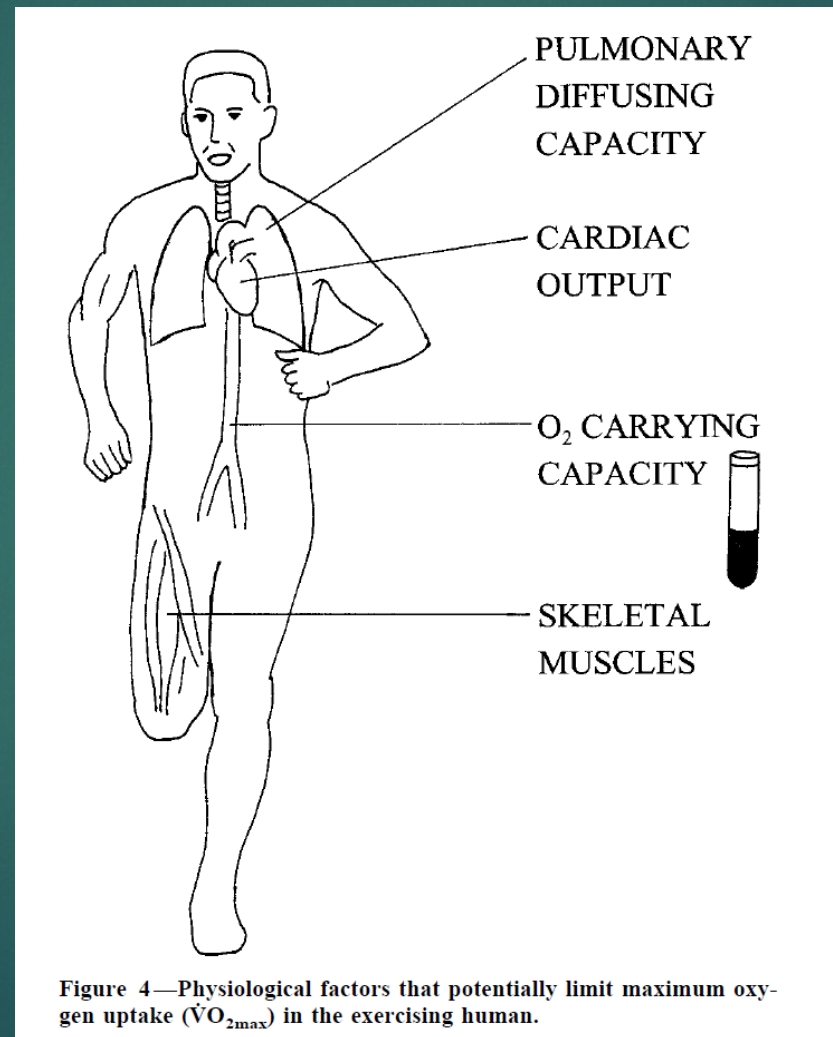
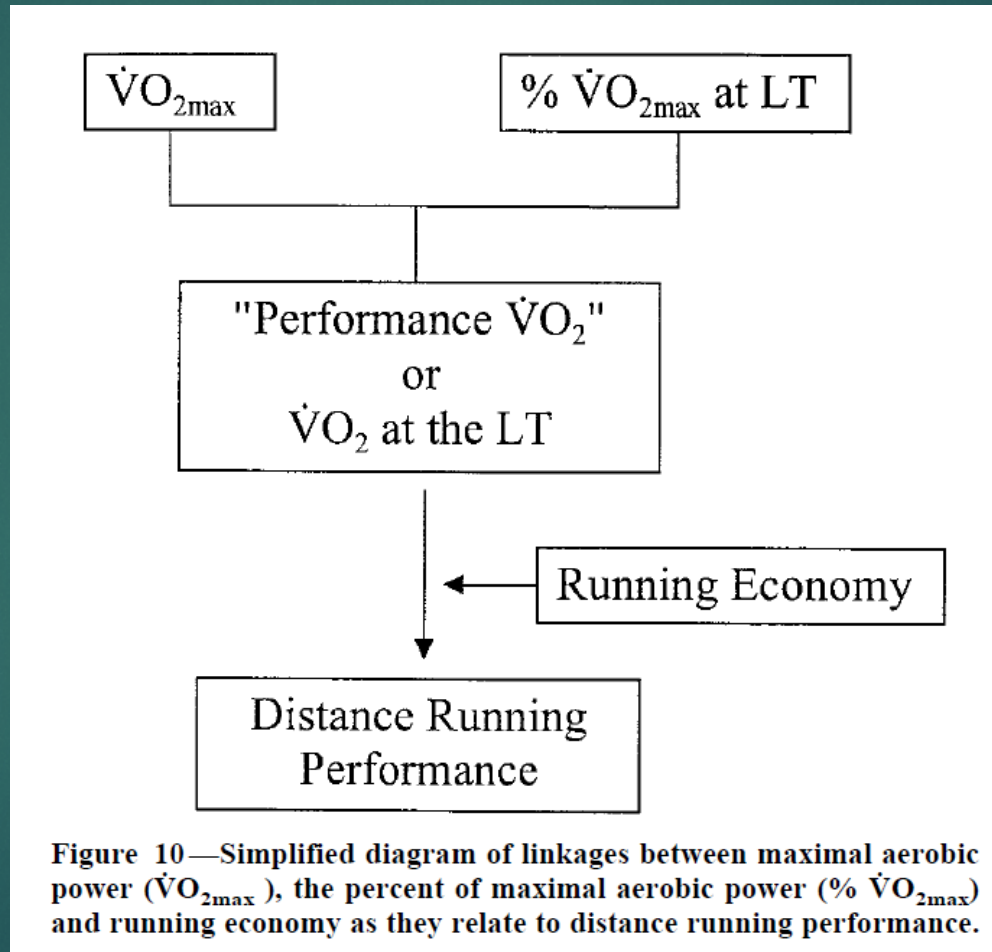


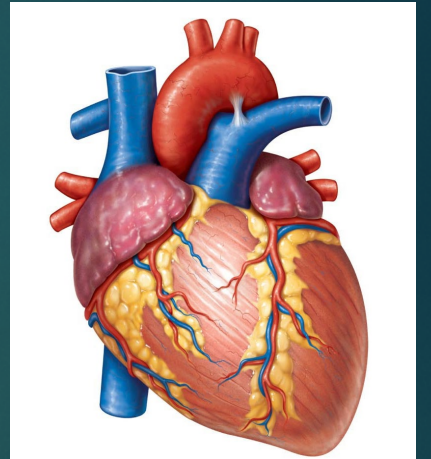
Figure 4—Physiological factors that potentially limit maximum oxygen uptake ($\dot{V}O_{2max}$) in the exercising human.

WHAT IMPACTS ENDURANCE PERFORMANCE?



TRAINING EFFECTS

- ▶ Endurance
 - ▶ Develops the central cardiovascular mechanisms that deliver oxygen to the muscles
 - ▶ Heart Size, Blood Volume, Stroke Volume
- ▶ Anaerobic threshold
 - ▶ Improved ability to clear lactic acid and use it for energy
 - ▶ Improves the muscles' ability to function efficiently in an acidic environment
- ▶ Above Anaerobic threshold:
 - ▶ Better oxygen extraction at higher intensities
 - ▶ Neuromuscular Coordination – muscles work together to produce higher power outputs
 - ▶ Increased ability of the body to deal with Lactic Acid (buffering)
 - ▶ Relevant pacing

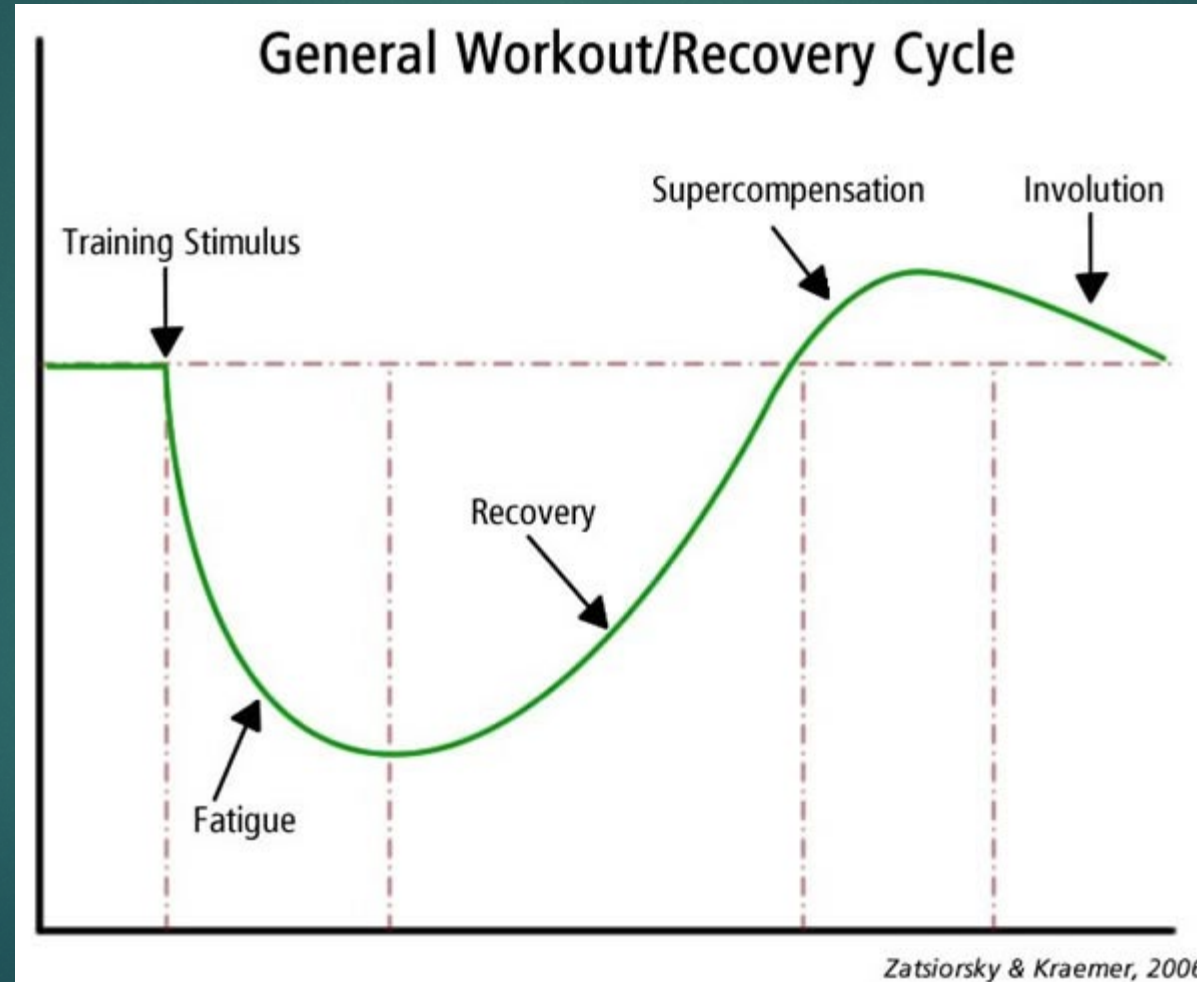


TRAINING EFFECTS

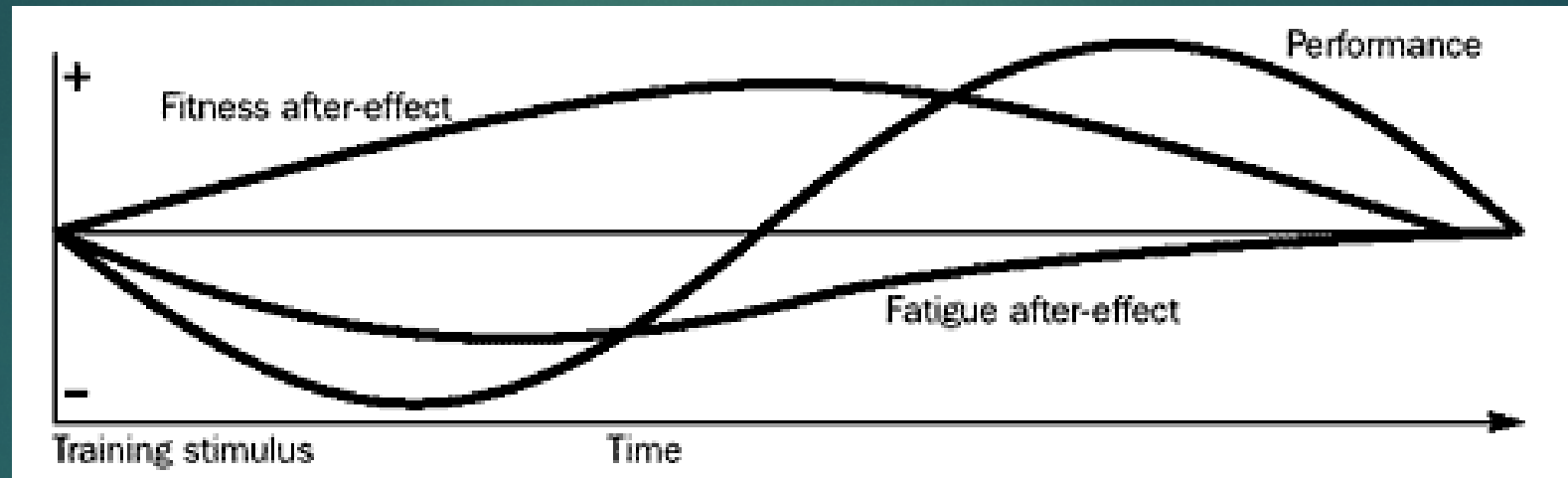
- ▶ Not just about the physiological adaptations
- ▶ **Technical component**
- ▶ Consider terrain



IMPORTANCE OF RECOVERY



IMPORTANCE OF RECOVERY



Bannister, 1990

TRAINING QUALITY

- ▶ What are some key factors impacting training quality?
 - ▶ HEALTH
 - ▶ Equipment
 - ▶ Execution

HEALTH

- ▶ Medical
 - ▶ Not just illness
- ▶ Musculoskeletal
 - ▶ Any areas of concern for risk of injury?
- ▶ Mental
 - ▶ Are there mental health factors that could limit the ability to train optimally?

EQUIPMENT

- ▶ You need to think of your equipment for all modes of training you do
 - ▶ Safety
 - ▶ Does it put you at higher risk of injury?
 - ▶ Functionality
 - ▶ Status of heart rate monitor?

EXECUTION

- ▶ Following the plan
 - ▶ Being diligent with training zones
 - ▶ Keep technique in the forefront of all training
 - ▶ Nutrition
 - ▶ Recovery
 - ▶ Being diligent with your Training Logs and any Monitoring your coach is asking from you
- ▶ Adapt the plan as needed
 - ▶ Make sure you are always communicating well with your coach!
 - ▶ Monitoring and Testing programs are in place to help us track and adjust to keep moving towards your goals.

Thank You!

