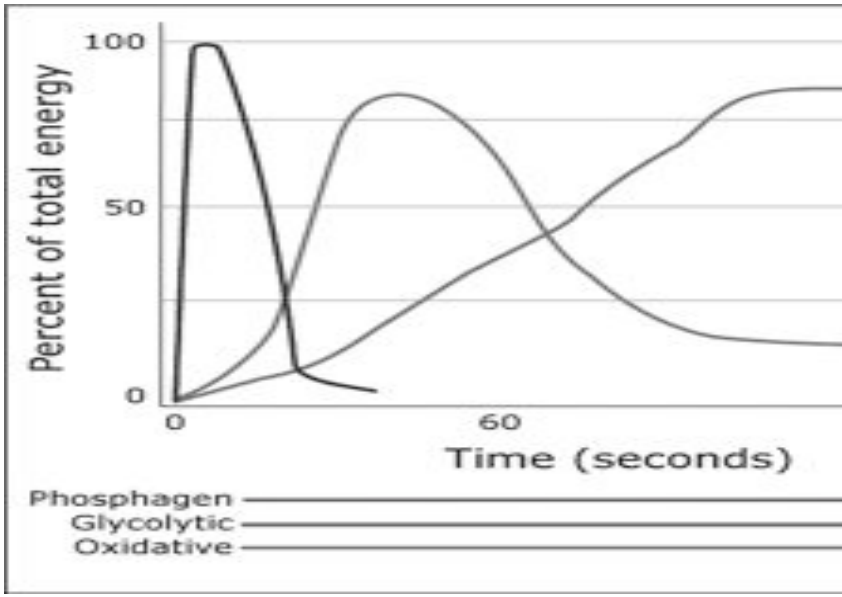
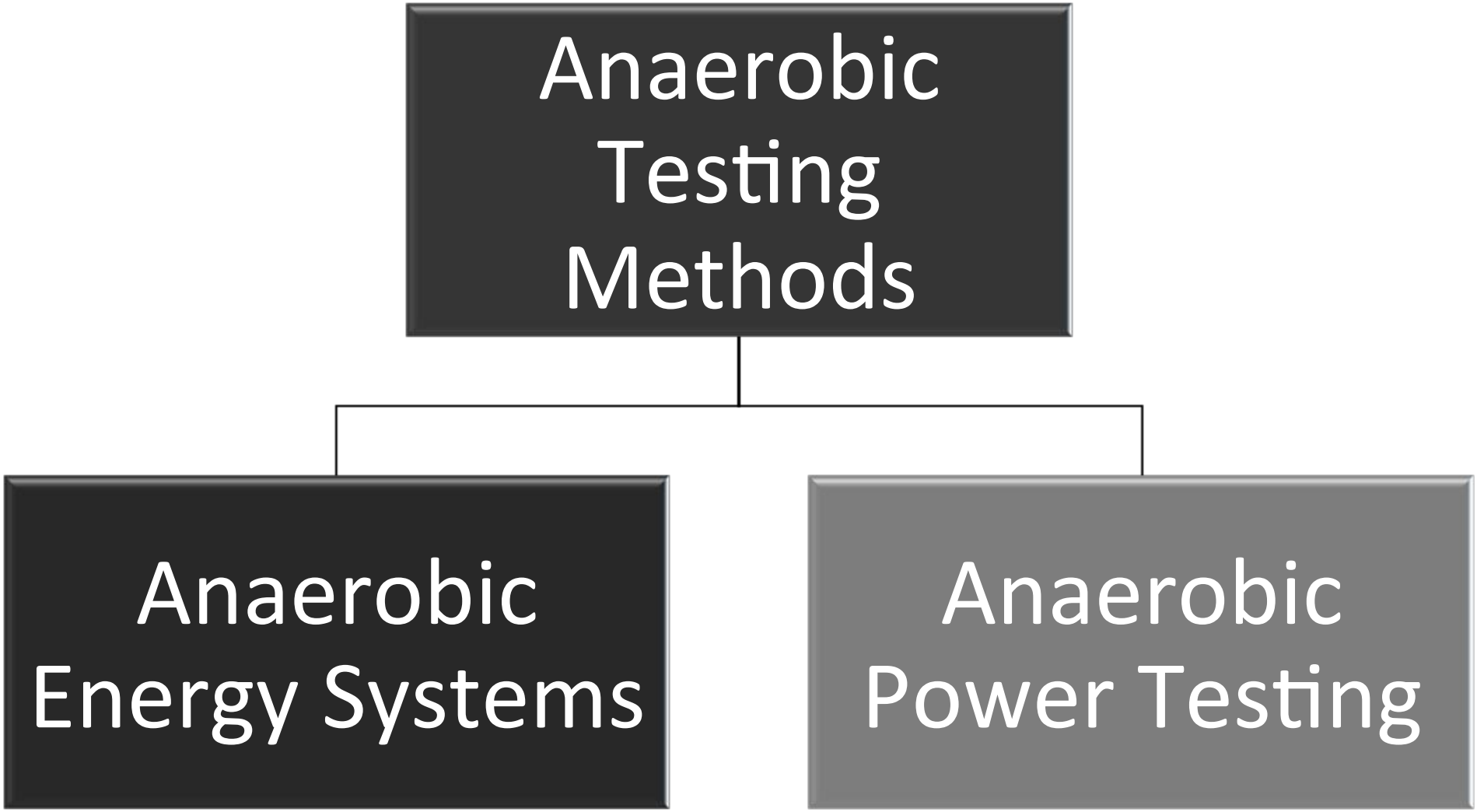
Anaerobic Testing Methods



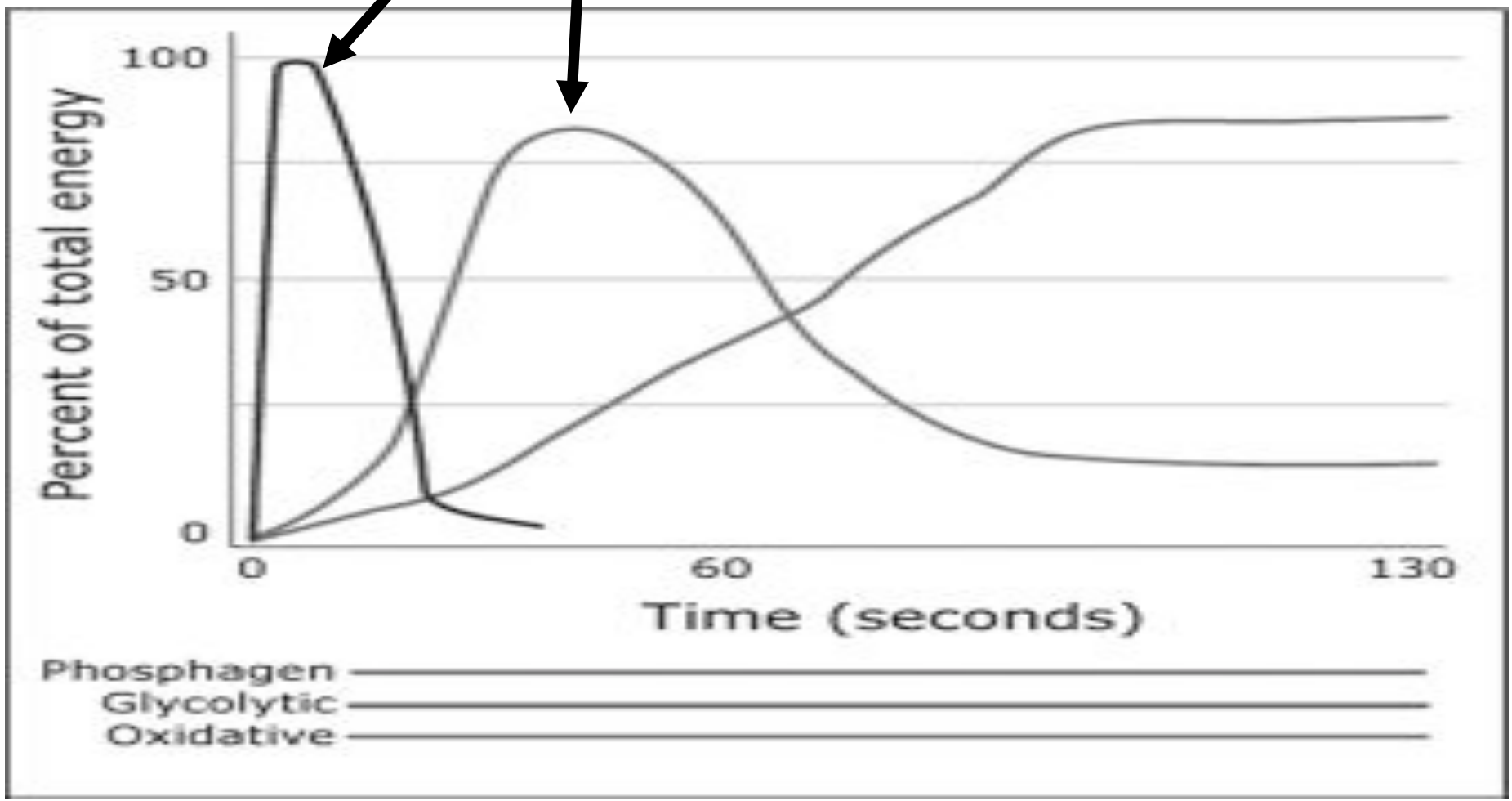
Methods of Anaerobic Measurement Overview

- Review of energy systems
- Anaerobic fitness classifications
- Lactate
- Maximal accumulated oxygen deficit
- Critical Power
- Gross efficiency
- Anaerobic Power Testing Methods


Anaerobic Testing Methods
Anaerobic Energy Systems
Anaerobic Power Testing

Energy System Contribution

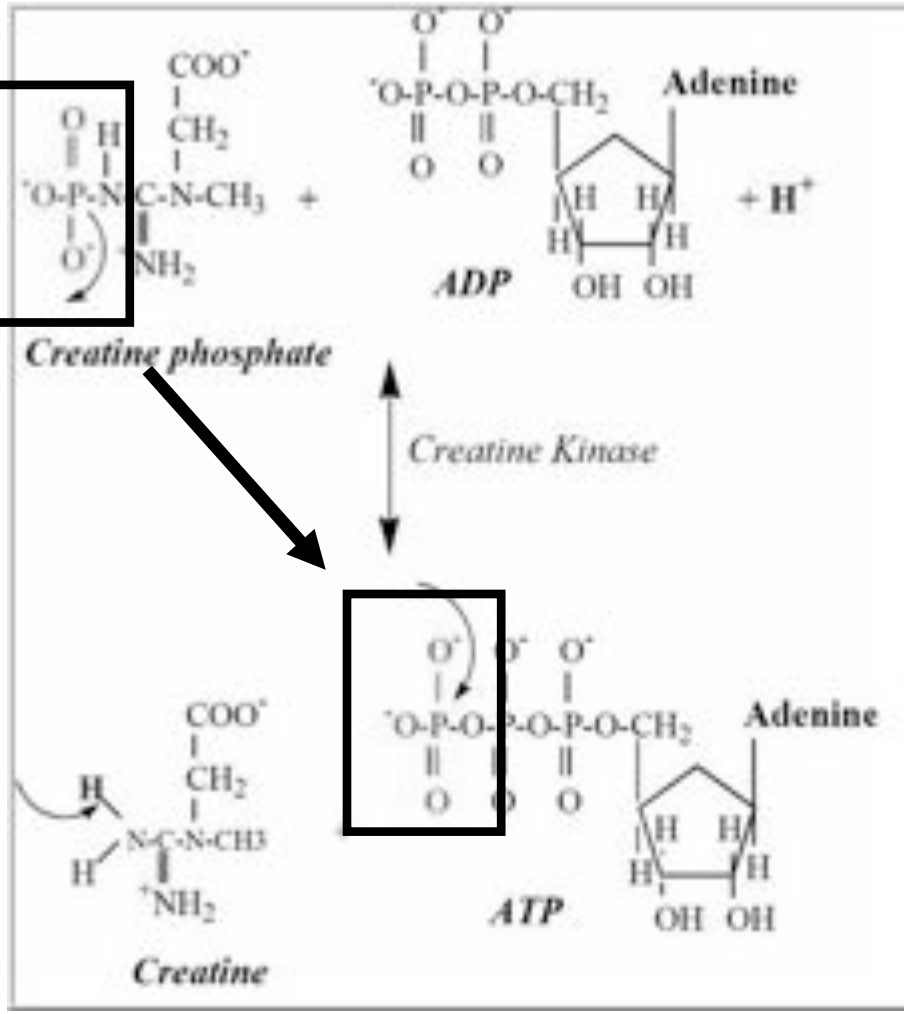
Anaerobic components



Phosphagen System Review

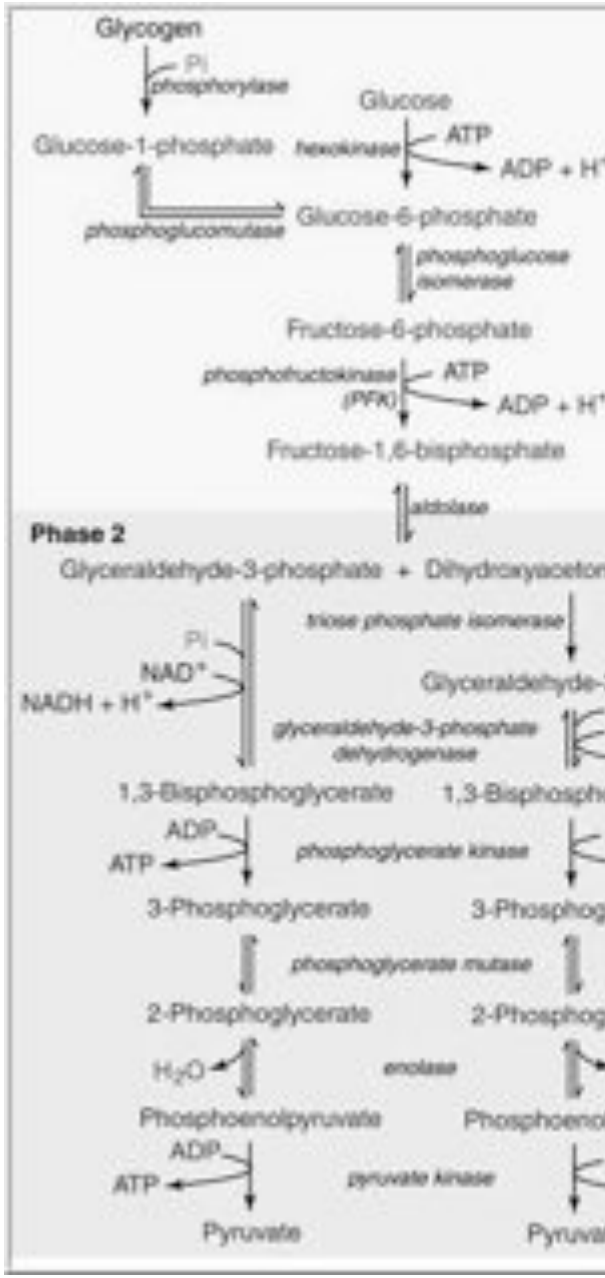
nmediate energy system

- Also called ATP-PCr system
- ~ 10 seconds
- Rephosphorylization of ADP by PCr

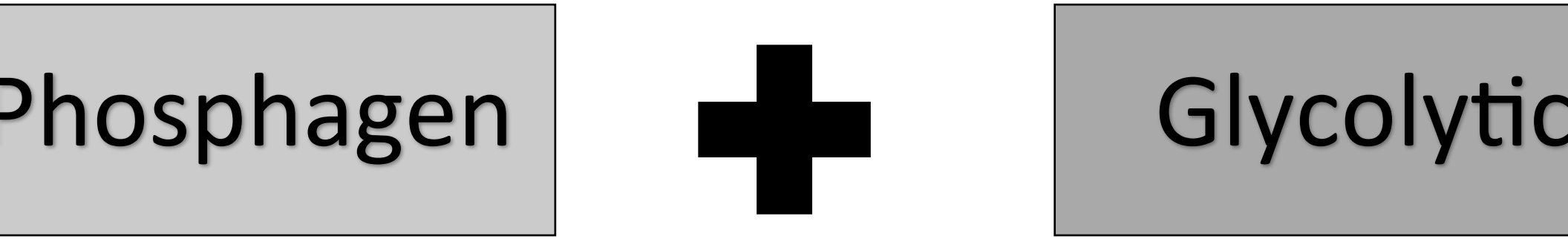


Glycolysis Review

- Breakdown of stored glucose to produce ATP
- Provides energy for short, high intensity bursts
  - Lasts from seconds to minutes



Anaerobic Energy System



Anaerobic Energy System

Quiz!

- What two energy systems comprise the anaerobic energy system?
- How long during intense exercise is the phosphagen syste the greatest ATP contributor?
- What is another name for this energy system?
- How long during intense exercise is glycolysis the greates ATP contributor?

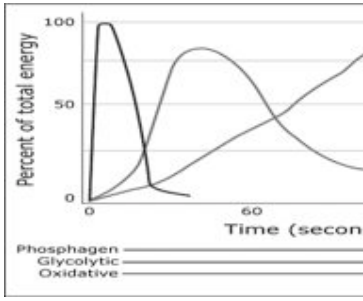
How Anaerobic Fitness is Classified

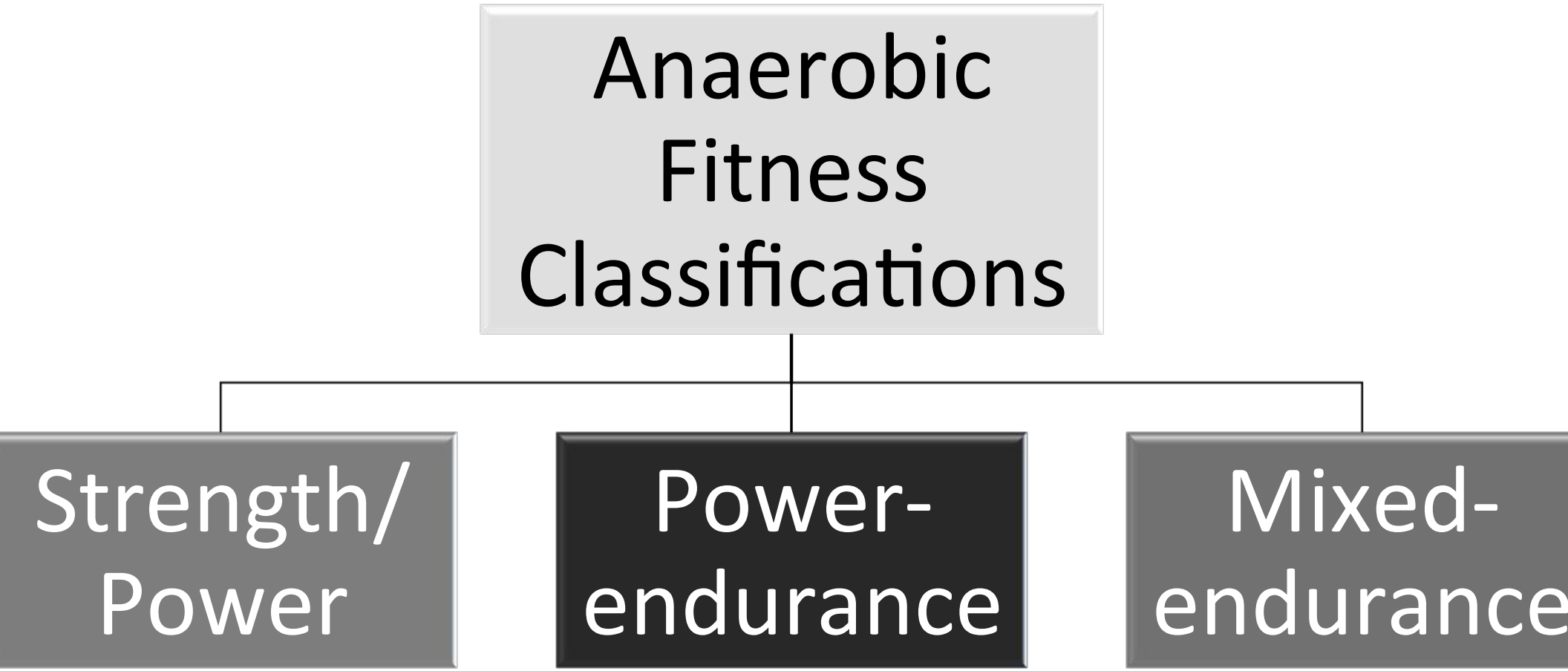
Intensity

Anaerobic Fitness Class

Duration

ATP contribution




Anaerobic Fitness Classifications
Strength/ Power
Power-endurance
Mixed-endurance

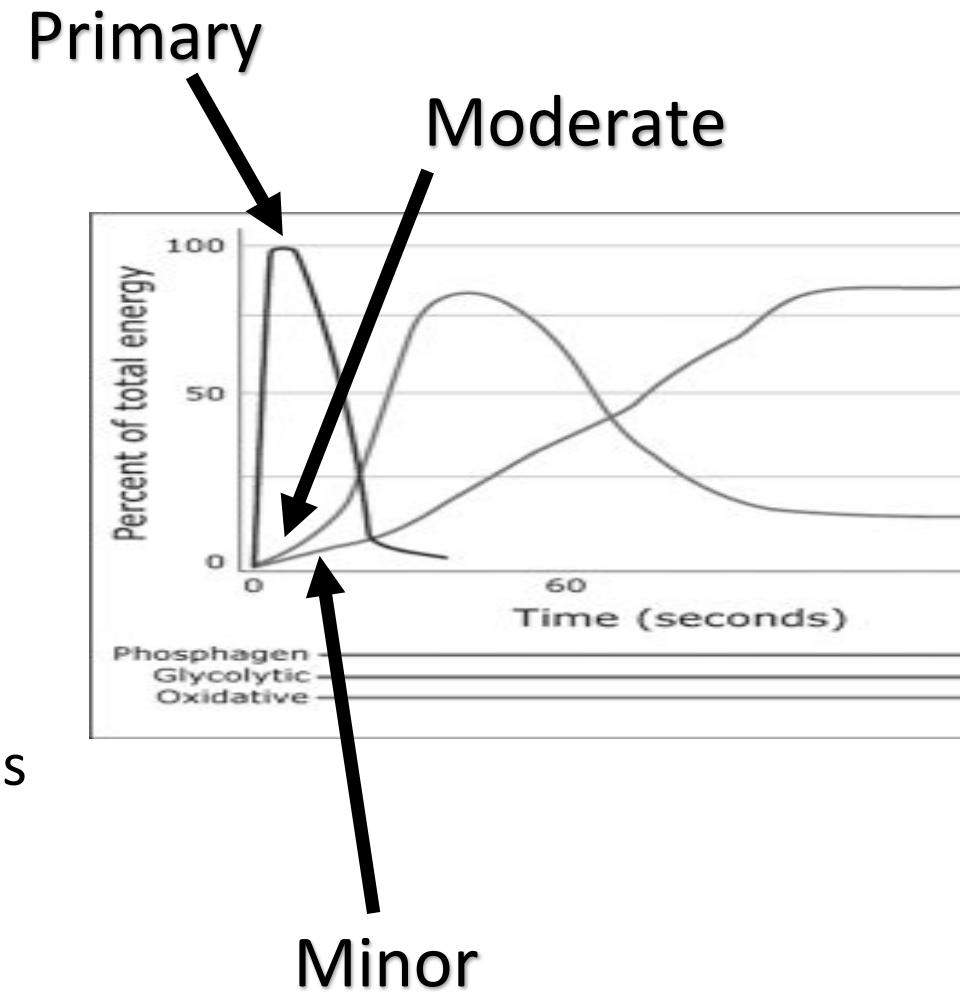
Strength/Power Fitness

Short duration! (< 15 seconds)

- Phosphogenic – primary ATP producer
- Glycolytic – moderate
- Oxidative – minor

Power depends on:

- Storage capacity of CrP and ATP
- Rate of CrP and ATP use and re-synthesis
- Partially dependent on glycogen stores



Strength/Power Fitness Examples

m Run- U. Bolt

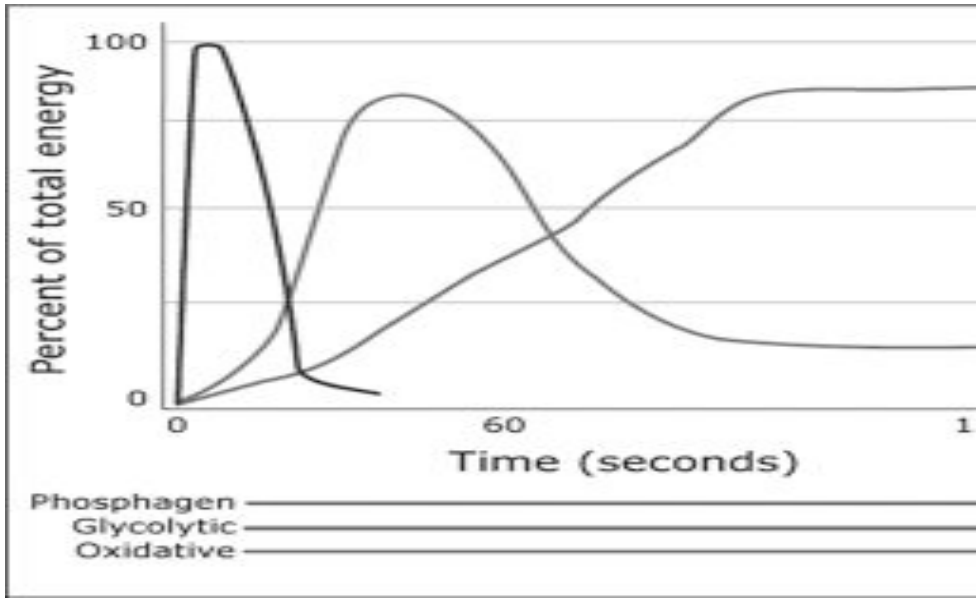
Sports with explosive movement

Power-endurance

Duration: 15-60 seconds

Energy system contribution depends on duration:

- 15-30 sec
  - Phosphogenic and glycolytic – major
  - Oxidative – minor
- 30-60 sec
  - Glycolytic – major
  - Oxidative – minor
  - Phosphagen – minor



Power dependent on:

- Glycogen energy stores
- ATP/CrP use/re-synthesis

Power-Endurance Fitness

Most of the same sports as strength-power

00m Run U. Bolt 19 sec

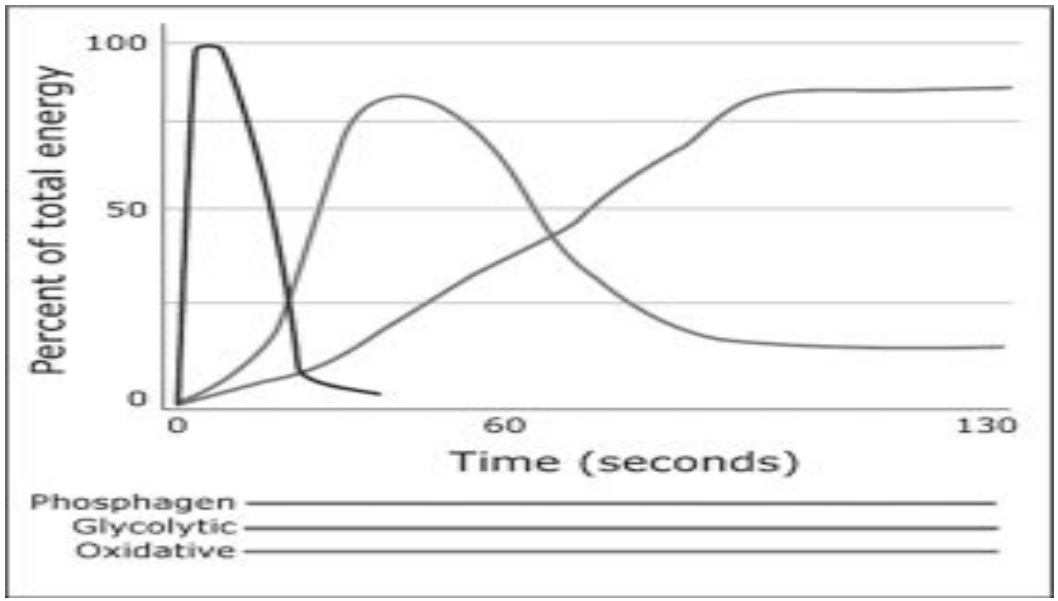
300m Run U. Bolt 31 se

Mixed-endurance

Duration: 1 – 2 minutes

Equal ATP contributions from glycolytic and oxidative pathways

- Relative contribution of each depends on intensity



Rudisha of Kenya
800m 1:41

Quiz!

- What 3 factors determine anaerobic fitness type?
- What is the dominant energy system and duration for each type of anaerobic fitness?
- Give an example of an activity for each anaerobic fitness type.

Anaerobic Measurements

- Anaerobic power: peak **rate** of ATP produced via anaerobic metabolism

- Anaerobic capacity: maximal **amount** of ATP that can be generated through anaerobic metabolism

Methods used to evaluate energy release

erobic Measurements:

Direct relationship between **VO_2** and aerobic production of **ATP**

ndirect calorimetry provides basis or aerobic energy measurements

Anaerobic Measuremen

- **No universally accepted meth** to directly measure anaerobic energy production exists

How do we measure anaerobic capacity?

Most commonly used methods of measuring **anaerobic capacity**:

- Lactate
- Maximal accumulated oxygen deficit
- Critical Power
- Gross Efficiency

Quiz!

- Define anaerobic power and anaerobic capacity.
- What are the most commonly used methods to measure anaerobic capacity?

Origins of Lactate Measurements

rzelius (1841)
First researcher to suggest measuring anaerobic energy

ndsgaard (1932)
Alactacid or “lactacid anaerobic energy output” coined

Alactacid energy from splitting of ATP and creatine phosphate stored in muscle

Quantified via lactate formation in the blood

At the time known as “lactic acid”

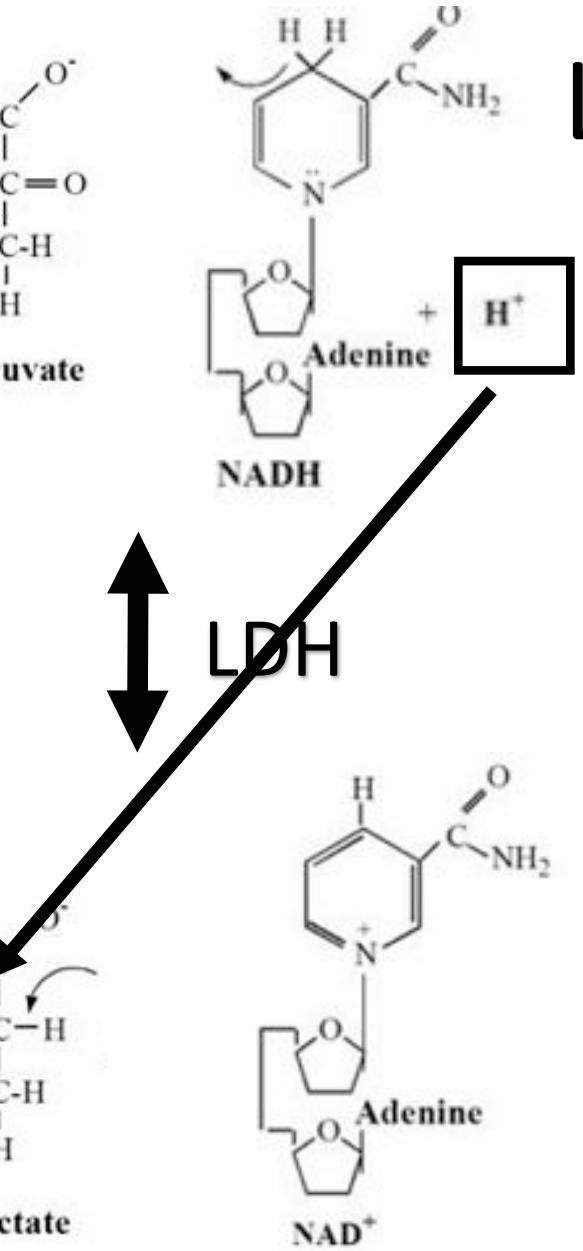
Where do we get the term lactic acid?

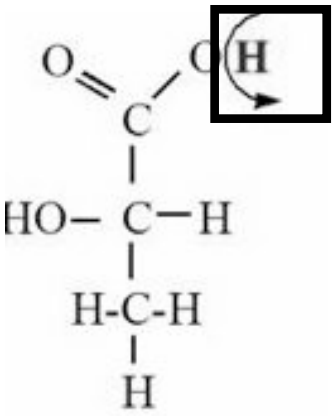
- 1780 lactic acid is discovered in sour milk
- 1810 lactic acid is confirmed in organic tissue
  - Fermented ox meat and blood “not human”
- At the time, no way to measure proton dissociation

+

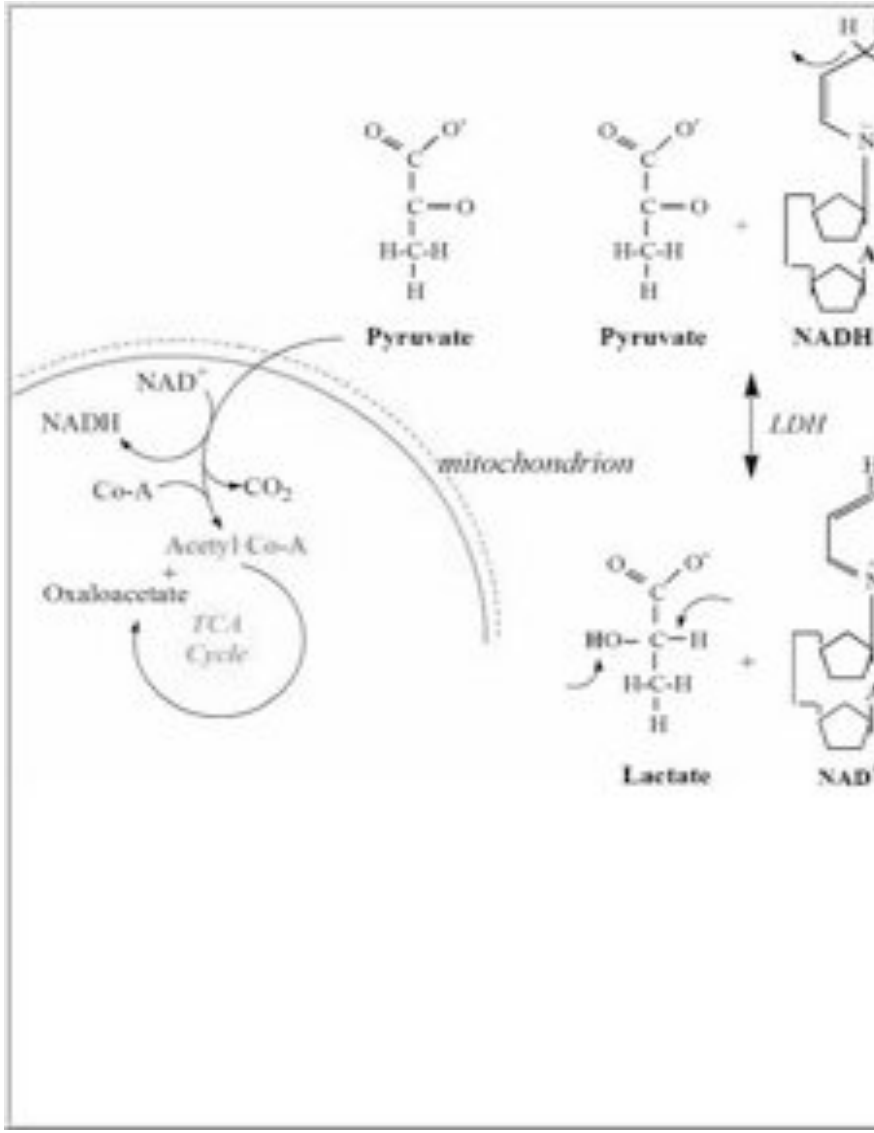
= Humar

Lactate vs Lactic Acid





Lactic Acid



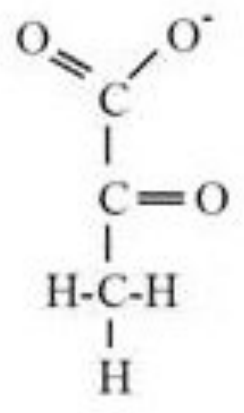
Pyruvate vs Lactate vs Lactic Acid

Lactate accepts H+ ions

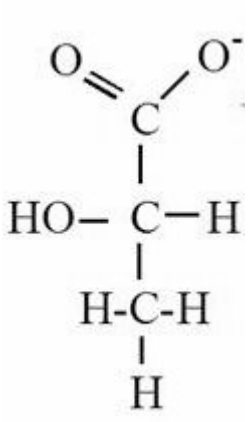
Lactic acid dissociates H+ ions (strong acid – pH 3.67)

- Muscle cell pH ranges from 6.1-7.05

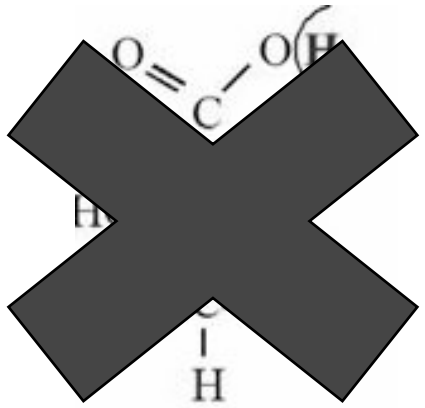
NO lactic acid in the human body!!



Pyruvate



Lactate



Lactic Acid

Quiz!

- Why is it incorrect to use lactic acid and lactate interchangeably?
- Will you ever say we produce lactic acid again?

How is lactate measured?

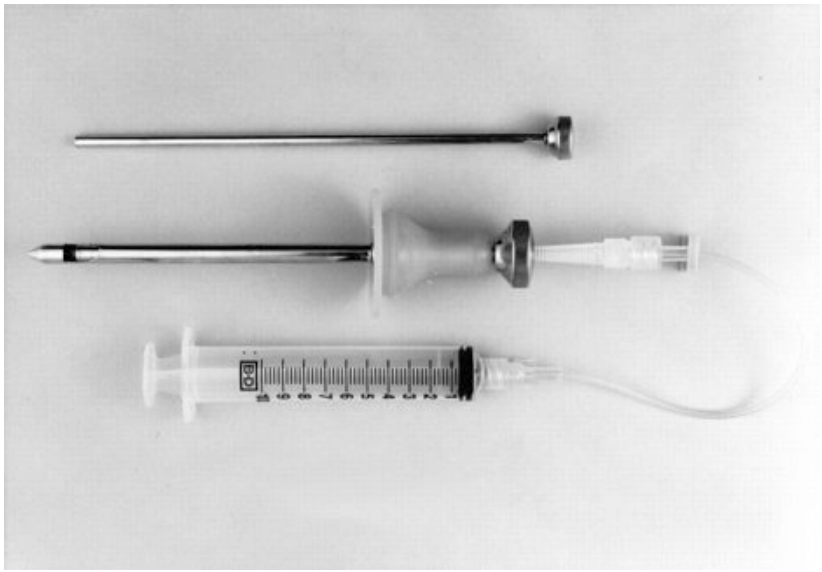
Blood

OR

Muscle

Muscle biopsy is developed!

- 1937 Sacks and Sacks
  - Blood lactate formation is not a direct measure of muscle lactate
  - Developed the needle biopsy technique
  - Now possible to measure muscle metabolites (lactate, ATP, CrP, pyruvate)



Are muscle biopsies the best method?

nitations of muscle biopsy:

Invasive

Difficult to determine whole body response

Blood lactate release not measured

Limitations of lactate measurements

Blood and muscle lactate are not always the same

Gives indication of extent of glycolysis

- Phosphagen system?

Lactate measured in the blood peaks at varying times following exercise

Lactate in muscle declines rapidly

Quiz!

- Where do we typically measure lactate?
- What are the limitations to doing a muscle biopsy to measure lactate?
- What are some limitations of using lactate as a determinant of anaerobic capacity?