

2A/2B EXERCISE PHYSIOLOGY



CONTENT

Components of fitness

- Cardio respiratory endurance
- Muscular strength
- Muscular endurance
- Flexibility
- Body composition
- Agility
- Balance
- Coordination
- Reaction time
- Speed
- Power

Training principles

- Specificity
- Intensity
- Duration
- Frequency
- Progressive overload
- Reversibility

CONTENT

Training methods

- Resistance training
- Interval training
- Continuous training
- Circuit training
- Fartlek training
- Flexibility training
- Plyometrics

Energy systems

- ATP
- ATP-PC system
- Anaerobic glycolysis (lactic acid system)
- Aerobic energy system
- Energy system interplay

Nutrition

- Proteins
- Fats
- Carbohydrates
- Fuelling energy systems

CONTENT

Immediate responses to Physical activity - CIRCULATORY

- Heart rate
- Stroke volume
- Cardiac output
- Blood pressure
- Temperature regulation
- Selective redistribution of blood
- Av-o₂ difference

Immediate responses to Physical activity - RESPIRATORY

- Respiration rate
- Gas exchange
- Oxygen uptake
- Tidal volume

Long term aerobic adaptations to training

- Cardiovascular adaptations to training
- Respiratory adaptations to training
- Muscular adaptations to training
- Summary aerobic training adaptations

Long term anaerobic adaptations to training

- Muscular adaptations to training

TRAINING PRINCIPLES - SPECIFICITY

- Involves the training of **SPECIFIC** energy systems, fitness components, muscle groups, positions and roles within a given sport.
- This information is gathered through a games analysis to understand the specific demands of the sport
- Athletes get what they train for – swimming training does not improve cricket skills.

To ensure the principle of specificity is applied, we have coaches specific to playing positions to ensure a professional athletes training is tailored towards the individual demands of the position



TRAINING PRINCIPLES - INTENSITY

- Amount of effort applied in a training activity or session.
- Measured using following:
 - Heart-Rate (%HR max)
 - Oxygen uptake (%VO₂ max)
 - Lactate concentration
 - Maximal speed
 - Rating of perceived exertion charts

| TRAINING ZONE | |
|---------------|-----------------------|
| >85% max HR | Anaerobic training |
| 65-85% max HR | Aerobic training zone |
| <60% max HR | Fat training zone |



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TRAINING METHODS

RESISTANCE (WEIGHTS) TRAINING

- Manipulation of repetitions, sets , %1RM and recovery between sets determines type of weights training
 - Local muscular endurance
 - Hypertrophy
 - Strength
 - Power

| | Speed of contraction | %1rm | Volume (sets x reps) | Recovery |
|-------------|----------------------|---------|----------------------|------------|
| Endurance | medium | 40-50% | 2-3 x 15-30 | 30sec-1min |
| Hypertrophy | slow | 65-75% | 4-6 x 12-15 | 30sec-1min |
| Strength | slow | 70-100% | 3-5 x 1-10 | 2-3min |
| Power | fast | 30-60% | 2-3 x 10-12 | 2-3min |



TRAINING METHODS

3. PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION (PNF)

- Advanced form of flexibility training involving the contraction and stretching of specific muscle groups
- Should only be performed under the guidance of individuals as there is a risk of overstretching causing injury

STEP 1 - assume the position to stretch. Extend the body limb until the muscle is stretched and slight tension is felt.

STEP 2 - The athlete then contracts the stretched muscle for approx 5 - 8 sec whilst the partner inhibits all movement by providing resistance.

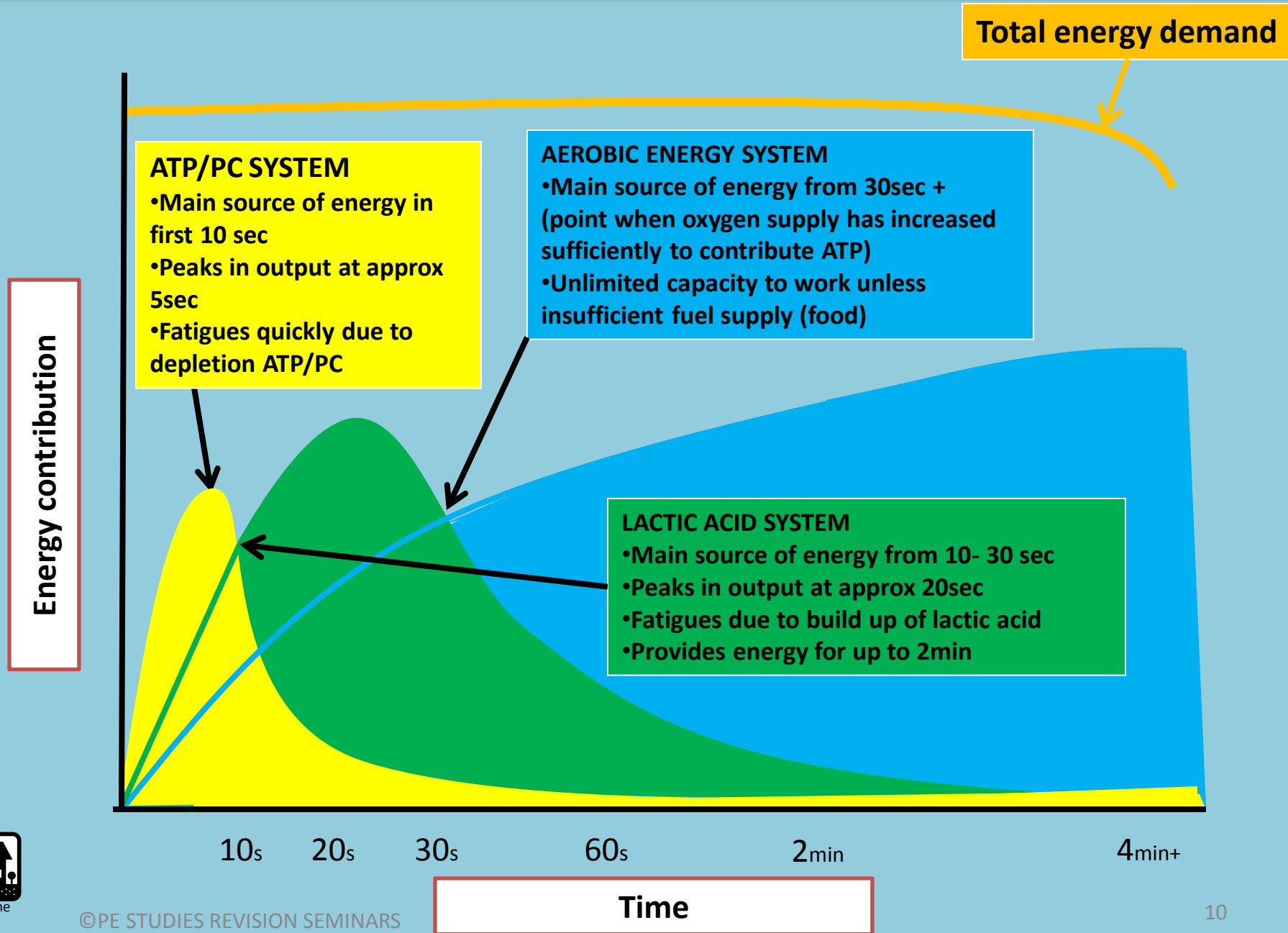
STEP 3 - The muscle group is relaxed, then immediately pushed past its normal ROM for approx 20-30 seconds.



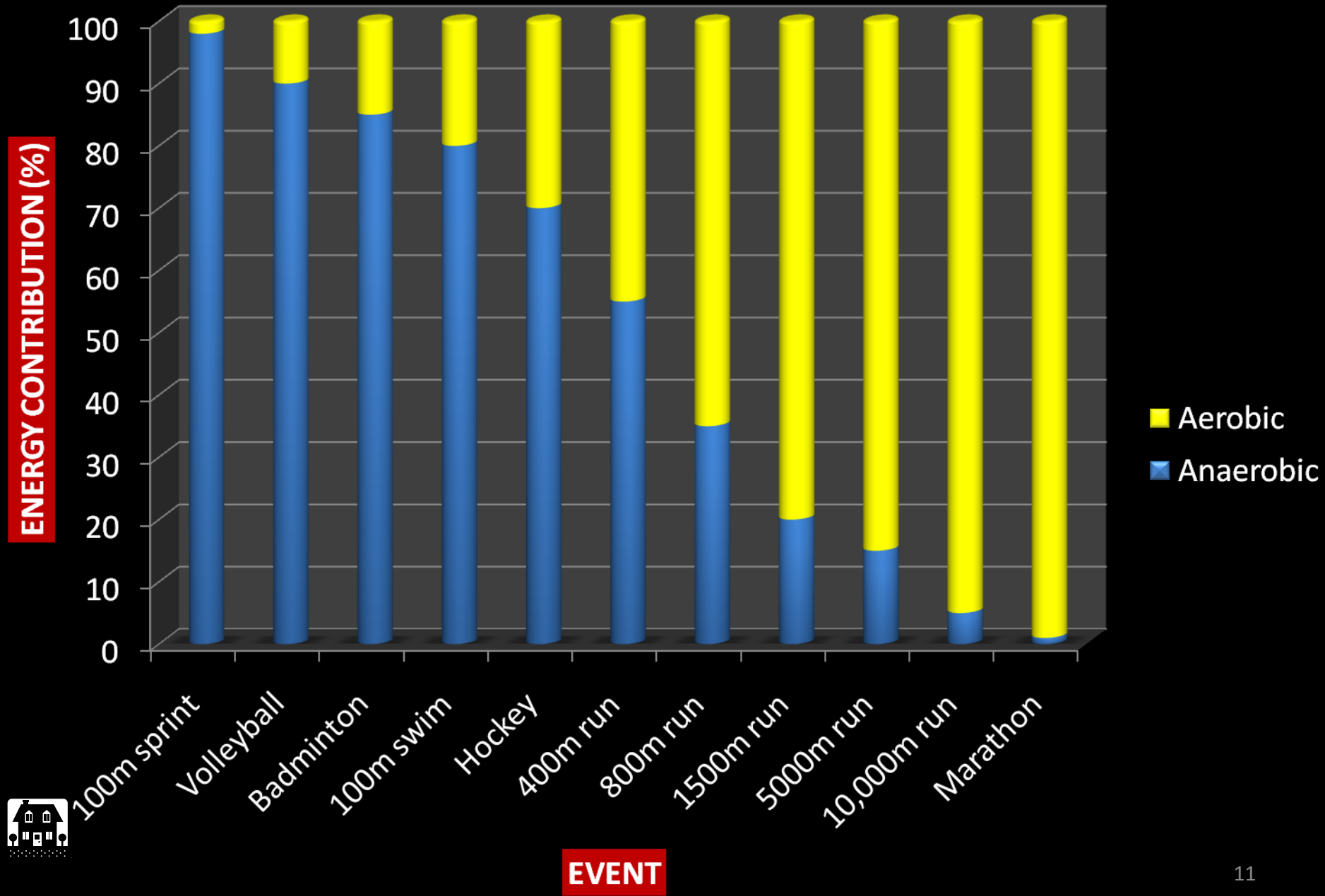
3 ENERGY SYSTEMS

| | ATP/PC SYSTEM | ANAEROBIC GLYCOLYSIS (Lactic acid system) | AEROBIC ENERGY SYSTEM |
|--------------------------|------------------------|---|--|
| O2 Required | No | No | Yes |
| Speed of energy supply | Very fast | Fast | Slow |
| Fuel Source | Creatine Phosphate | Carbohydrates | Carbohydrates & fats (protein in extremes) |
| Amount of ATP Production | Limited | Limited | Unlimited |
| By Products | None | Lactic acid | CO2 ,H2O & Heat |
| Duration | 0-10sec | Up to 2min | Forever |
| Cause of fatigue | Limited supply ATP/PC | Lactic acid production | Unlimited |
| Activity | Power based activities | Sprint endurance | Long duration |

ENERGY SYSTEM INTERPLAY DURING EXERCISE TO EXHAUSTION



ENERGY SYSTEM INTERPLAY



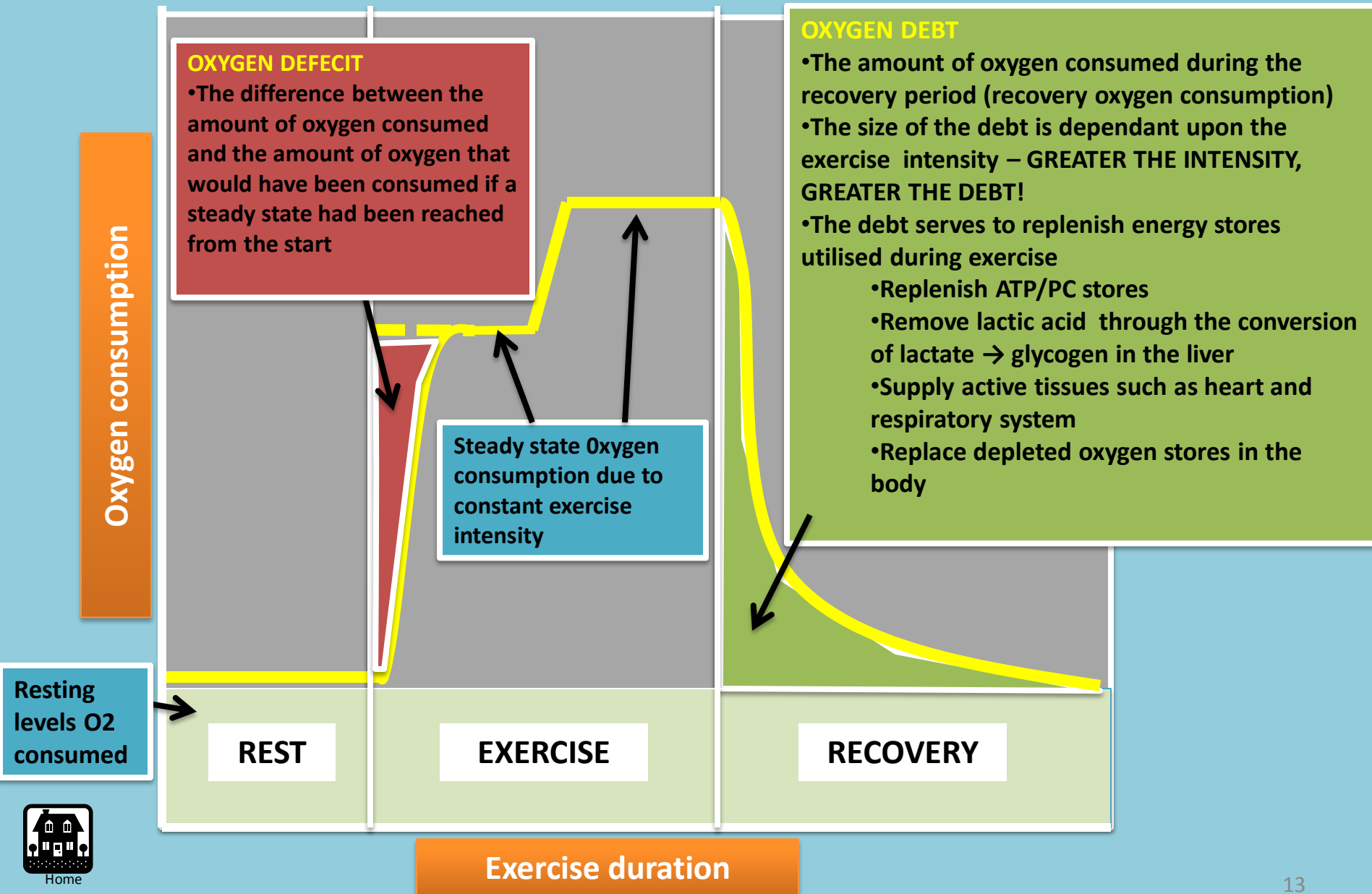
ACUTE CIRCULATORY RESPONSES TO PHYSICAL ACTIVITY

| | SEDENTARY MALE | ENDURANCE TRAINED MALE ATHLETE |
|--|----------------------|--------------------------------|
| HEART RATE (bpm) REST MAXIMUM | 70-80bpm 220-age | 40-50bpm 220-age |
| STROKE VOLUME (ml) REST MAXIMUM | 60-70ml 100-110ml | 90-100ml 150-180ml |
| CARDIAC OUTPUT (L) REST MAXIMUM | 5L 15-20L | 4.5-5L 25-35L |

NOTE: Cardiac output in trained athletes is the same, even slightly lower during sub maximal exercise and rest due to the significantly lower heart rate



OXYGEN CONSUMPTION BEFORE, DURING AND AFTER EXERCISE



LONG – TERM (CHRONIC) AEROBIC TRAINING ADAPTATIONS – PERFORMANCE CHANGES

↑ ANAEROBIC OR LACTATE THRESHOLD

- Represents an exercise level where the intensity increases such that lactic acid production exceeds lactic acid clearance.
- It is beyond this level where blood and muscle lactate levels rise quickly and muscular contractions are affected, negatively affecting performance.
- Trained athletes are much better able to tolerate lactic acid and can therefore continue to exercise effectively with much higher levels of lactate and hydrogen ions.

| Physiological method of determining lactate threshold | Determinant |
|---|---------------------------------------|
| % HR max | UT – 60-65% TR – 85-90% |
| % VO2 max | UT – 55-60% TR – 75-85% |
| Blood lactate levels | UT – 3-4mmol/L TR – up to 20mmol/L |

