

# Sport Fitness – defining, testing, improving

P. Bevis

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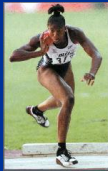
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## Components of Fitness

Stamina (CR endurance)

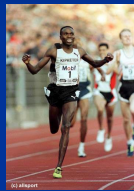
Muscular endurance



Strength

Speed

Flexibility - ROM



Agility

Balance

Body Composition

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## Fitness Questions - Exams

What is it?



How do I test it?



How do I improve it?



When do I use it?



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## Cardio-respiratory endurance

- Concerned with ability to transport and use oxygen to release energy
- Delay fatigue
- Component of most games because of duration of continuous movement
- Range of direct or predictive  $VO_2$  tests



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## Muscular endurance

- Ability of muscle to keep contracting
- Ability to use oxygen for energy and not build up lactate in muscles
- Component to some games and activities because of repeated actions
- Multistage sit-up test – reliable but not very valid



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## Strength

- Overcome resistance
- Component of some activities because of resistance
- Maximisation of muscle contractions
- Static – use dynamometer – grip, leg
- Dynamic – one rep max
- Accurate measure of strength
- Exercise/muscle group specific
- Repeatable for different exercises/ muscle groups



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## Speed

- Ability to move parts (whole) of body quickly
- In many activities because of need to move quickly/generate power
- Use of fast-twitch muscle fibres
- Test - sprinting times; hand/leg movements
- Out of activity situation



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## Power

- Combination strength + speed
- Component of most activities because of need to move large body parts/whole body quickly
- Sargeant jump; standing long jump
- Direct measurement of power – distance achieved involves moving mass
- Specific to legs
- Accurate



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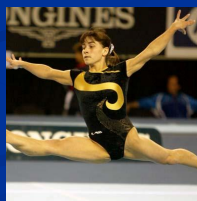
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## Fitness – flexibility

- Move joints through a wide range of movement (ROM)
- Most activities because of need to stretch to reach
- Limits to movement – bones, ligaments, muscles and tendons
- Sit and reach test, goniometers



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## Agility

- Ability to change direction quickly
- Component of most activities because of need to change direction
- Combination speed + balance
- Illinois agility run
- Not activity related

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## Balance

- Stay in equilibrium
- Component of most activities (dynamic balance) because of need to maintain control whilst moving
- Concerned with base of support and centre of gravity
- Flamingo balance – static, not activity related



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## Body composition

- % of lean tissue to fat tissue
- High fat levels limit performance especially in body weight-bearing activities;
- Some activities are weight-restricted
- Concerned with bone, muscle and adipose tissue
- Skin-fold callipers, bioelectrical impedance



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## Component Fitness Testing

### Component Tests

Name, describe, component, limitations

Maximal - Sub-maximal

### Limitations

Out of activity situation.  
Inter-relationship of components

### Validity

Measures what it claims

### Reliability

Repeat test – get same result  
Control variables

### Ethical

Health and safety, tests to destruction

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## Objective, Subjective Tests

- Objective tests provide quantifiable measures of performance - (metres/seconds/runs/points)
- Subjective tests provide judgments about quality of performance – no units

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## Maximal and sub-maximal tests

- Maximal – exercise to exhaustion – need high motivation
- Sub-maximal – exercise to less than maximal and extrapolating results (heart rate) to estimate maximal values

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## Direct and indirect tests

- Most concerned with cardio-respiratory endurance/stamina -  $VO_2$  max
- Direct involves measuring  $VO_2$  max
- Indirect involves estimating  $VO_2$  max – by measuring heart rate

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## Physiological tests

### Heart Rate

- Pulse taking is cheap and simple
- Pulse meter more accurate and less distracting; doesn't require performer to stop

### Respiration

- Use breath volume bags (Douglas bags) linked to one-way valve to measure vital capacity
- Maximum expiration into the bag following a maximum inspiration

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## Predictive tests

- Maximum heart rate corresponds to exercise at a maximum workload
- Heart rate is related to workload over a range of exercise intensities
- Use heart rate measures to estimate maximum heart rate/workload

**Step Tests** – protocol, step height cadence etc. Simple but outmoded

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### **Predictive Multistage shuttle run test**

- Predicts  $VO_2$  max
- 20-metre shuttles using tape-recorded timing; progressive; maximal; accurate; large groups
- Maximal – requires motivation; favours runners

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### **PWC<sub>170</sub> cycle ergometer test**

- Measures aerobic fitness/stamina
- Standardised workload undertaken – heart rate measured
- Three workloads/heart rates taken
- Data extrapolated to find workload achievable at heart rate of 170bpm
- Accurate – measurement of both HR and workload

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### **Wingate power test**

- 30 seconds of all out cycling to determine anaerobic power
- Workload calculated according to weight
- Number of revolutions counted for every 5 seconds of test
- Graph produced of power against time
- Accurate – measurement of both power and time

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## Measuring VO<sub>2</sub> max - direct

- Usually treadmill running test, but may use cycling, swimming, rowing.
- Needs to be non-specific for strength, skill, size, speed
- Sufficient duration for max response of cardio-vascular system (6-12 mins)
- Requires high motivation - it hurts!

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## Fitness Training Considerations

Performer's needs – base line  
Fitness components of activity  
Training principles  
Training methods  
Training year - major competitions

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## Training principles (1)

**S**pecificity – relevant to task – energy system, body area, movement  
**P**rogression – more intensity/ frequency/ duration  
**O**ver-training – insufficient rest is harmful  
**R**eversibility – Lose quicker than you gain  
**T**edium – variety, repetition is boring

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## Training principles (2) – F.I.T.T.

- F** – frequency (per day/week)
- I** – intensity (% of max)
- T** – time/duration
- T** – type/mode  
(continuous/intermittent)

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## Continuous training

- Continuous running, swimming, rowing or cycling - trains aerobic system - develops endurance
- Sub-maximal work
- Higher intensity – anaerobic systems
- Based on % of max HR (HR Zones)

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## Intermittent training

- Periods of work and recovery
- Adjust frequency, duration, intensity and recovery period
- Blocks of work = 'sets'
- Sets composed of repetitions
- Number of repetitions/intensity of the exercise – link to recovery interval – energy system
- Circuit training, weight training, shuttles

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## Determining intensity

- Lactate sampling
- Heart rate
  - Karvonen formula  
[(max HR - resting HR) x 0.6] + resting HR
  - Heart rate training zone
- Training pace/intensity - % of maximum

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## Heart rate zones

- Measured as a percentage of maximum heart rate
- Maximum heart rate (220 - age)
- Unfit – train at 50-70% of max HR
- Fit – train at 70-90% of max HR

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## Stretching

### Active

Involves voluntary muscle contractions to achieve stretch

Stretch held for 30-60 seconds

Relax muscle of end of range

### Passive

Use external force to increase range achieved – partner, gravity, body wt

Forcibly increase range achieve

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## Stretching - PNF

- Best way of increasing flexibility
- Hold stretch for 6 seconds
- Stretch reflex inhibited
- Isometric contraction
- Increase stretch

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