

Giovedì 5 Maggio 2011 h. 13:30÷15 MA14

Metodologia dell'allenamento I (2010/2011)

Luca P. Ardigò

Alta intensità/Breve durata

- input metabolico ('benzina consumata') può aumentare in una frazione di secondo di più di 50 volte (da ca 1 a 50 W kg⁻¹, 2.86÷143 mlO₂ kg⁻¹ min⁻¹)!

| <i>Fonti energetiche</i> | <i>Potenza max (W · kg⁻¹)</i> | <i>Capacità max (kJ · kg⁻¹)</i> | <i>Tempo di esaurimento alla potenza max</i> | |
|--------------------------------------|--|--|--|------------------------------------|
| Anaerobiche alattacide (idrolisi PC) | 72 52 56 | 0,85 0,75 0,75 | ~ 6 s | Sprinter Fondista Non atleta |
| Anaerobiche lattacide | 26 | 1,0 | ~ 40 s | Non atleta |
| Ossidative | 19 26 16 | da 4000 a 8000 | ~ 25 min | Sprinter Fondista Non atleta |

- 'motore' solo muscoli attivi (30% m, 20 kg su 70);
- 'motore' aumenta consumo di 50/.3≈167x;
- \dot{W} durante salto a piedi paralleli ca 4 volte 5" corsa v_{Max} ;
- 'motore' aumenta consumo ≈670x!!

di Prampero, edi-ermes 1985

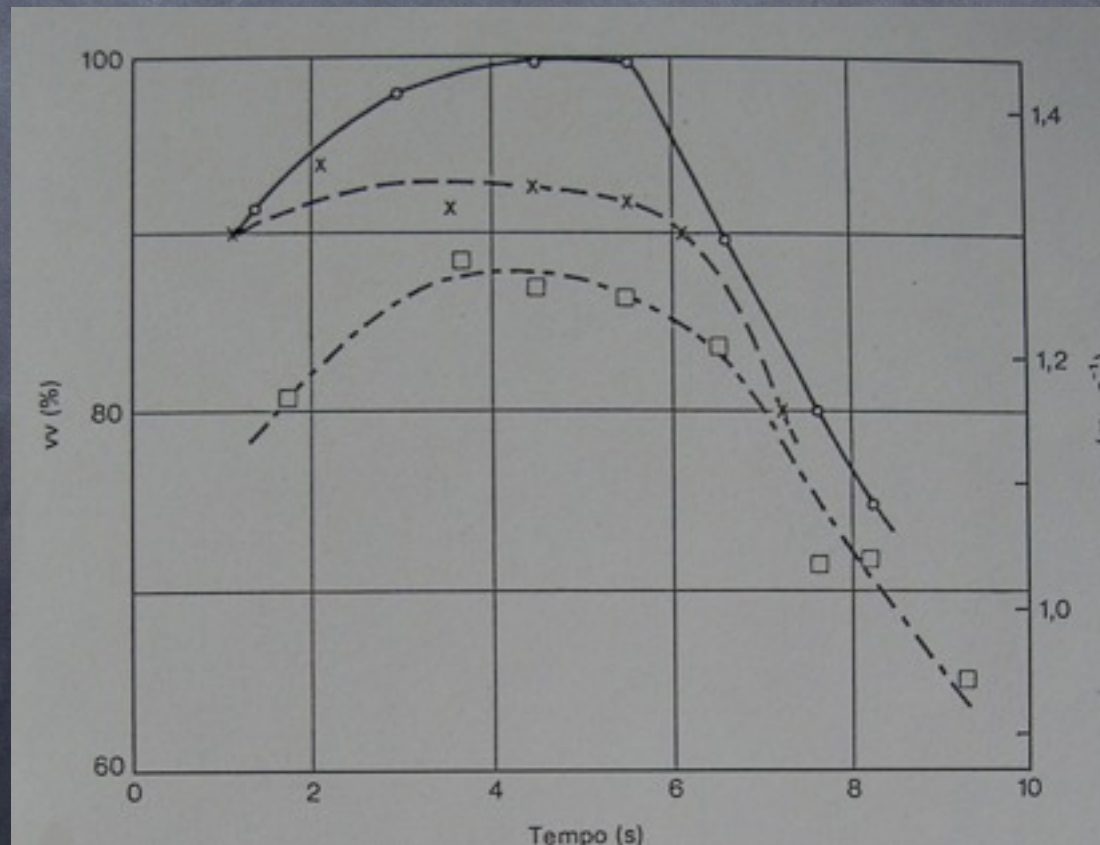
Alta intensità/Breve durata (2)

- PC \rightarrow ATP;
- $\dot{W} = \eta \dot{A}l$;
- $\dot{W}_{Max} = \eta \dot{A}l_{Max}$;
- Test di Margaria (Margaria et al., JAP 1966): salire scala 2-3 gradini alla volta v_{Max} corsa, misura v_{vi} ;

r
+18 ml O_2 kg⁻¹ min⁻¹
+35 ml O_2 kg⁻¹ min⁻¹
 $v_{vMax} = 1.45$ ms⁻¹
 $W_{Max} = 1.45$ kg_pm kg⁻¹
 $\dot{W}_{Max} = 1.45$ kg_pm kg⁻¹ s⁻¹
 $= 14.21$ W kg⁻¹

$\eta = 25\%$

$\dot{A}l_{Max} = \dot{W}_{Max} / \eta$
 $= 56.84$ W kg⁻¹



Alta intensità/Breve durata (3)

- Test di Ikuta ed Ikai (Ikuta et al., Res Phys Ed 1972): pedalare al cicloergometro a \dot{W}_{Max} e misura di \dot{W}_i ;

$\dot{W}_{Max} \approx .8 \text{ kW}$
 $= 11.42 \text{ W kg}^{-1}$
 \approx - ca $1/3 \dot{W}_{Max}$ Margaria

altav

-> η minore

-> $\dot{A}l_{Max}$ Ikuta & Ikai \approx $\dot{A}l_{Max}$ Margaria



Alta intensità/Breve durata (4)

- (salto a piedi paralleli) \dot{W} media ca 2 volte 5" corsa v_{Max} e \dot{W} picco ca 4 volte;

\dot{W}_{Max} media $\approx 15 \times 2 \text{ W kg}^{-1} = 30 \text{ W kg}^{-1}$

\dot{W}_{Max} picco $\approx 15 \times 4 \text{ W kg}^{-1} = 60 \text{ W kg}^{-1}$

(70 kg, 4.2 kW=5.7 CV)

(871 kg, 51 kW=69 CV)

\dot{W}_{Max} picco = $51,000/871 \text{ W kg}^{-1} = 59 \text{ W kg}^{-1}$



Variazioni sul tema

- test Margaria-Kalamen: no bisogno misura v_i , 16 gradini (3 alla volta) con misura t (.01") solo tra g3 & g9;
- test di Sargent (Sargent, Am Phys Ed Rew 1921): salto, problema standardizzazione;



- test Sargent-Lewis: durata salto 1"

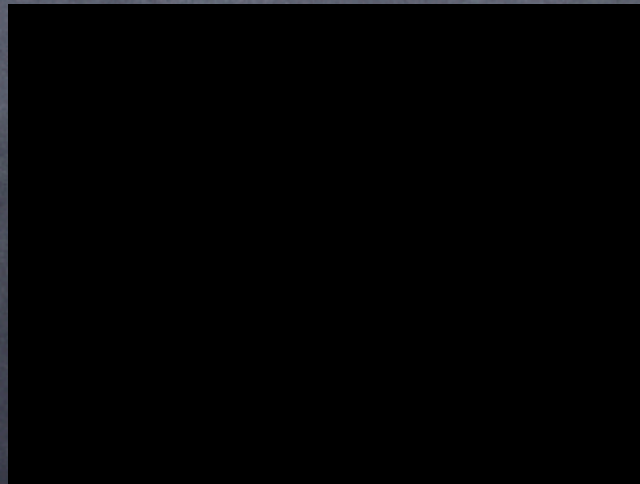
Alta intensità/Breve durata (bis)

- PC & glicogeno-lattato → ATP;

- Test di Wingate: pedalare free-wheeling a v_{Max} , carico improvviso, conta rivoluzioni 0÷5" → PC e 0÷30" → glicogeno-lattato

(<http://www.brianmac.demon.co.uk/want.htm>

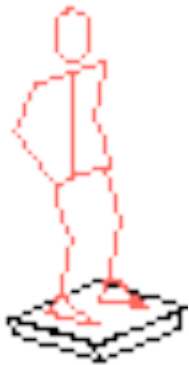
<http://www.brianmac.demon.co.uk/excel/wingate.xls>)



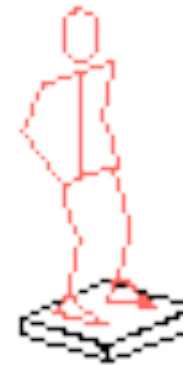
Alta intensità/Breve durata (bis2)

- test(s) di Bosco (Bosco et al., EJAPOP 50 1983, ...):

a) squat jump (PC);



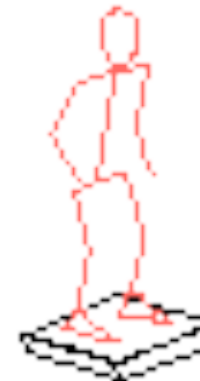
b) counter movement jump (+elastico);



c) continuous jump with bent legs
(+glicogeno-lattato);



d) continuous jump
with straight legs



- moto di un grave:

$$v_v = v_i - gt$$

$$0 = v_{Max} - gt$$

$$t = v_{Max} / g$$

$$t = 2v_{Max} / g$$

$$v_{Max} = gt / 2$$

Media-bassa intensità/Media-lunga durata

- carboidrati & lipidi → ATP;
- (glicogeno-lattato) ← lattacidemia;
- $\dot{V}O_2$ (soglia e $\dot{V}O_{2Max}$, capacità aerobica, protocolli x $\dot{V}O_{2Max}$ e soglia);
- economia (protocolli x economia)



Table 15.5 Treadmill Protocols

A—Protocol for Poorly Fit Subjects (60)

| Stage* | METs | Speed (mph) | % Grade |
|--------|------|-------------|---------|
| 1 | 2.5 | 2 | 0 |
| 2 | 3.5 | 2 | 3.5 |
| 3 | 4.5 | 2 | 7.0 |
| 4 | 5.5 | 2 | 10.5 |
| 5 | 6.5 | 2 | 14.0 |
| 6 | 7.5 | 2 | 17.5 |
| 7 | 8.5 | 3 | 12.5 |
| 8 | 9.5 | 3 | 15.0 |
| 9 | 10.5 | 3 | 17.5 |

*Stage lasts three minutes

B—Protocol for Normal, Sedentary Subjects (11)

| Stage* | METs | Speed (mph) | % Grade |
|--------|------|-------------|---------|
| 1 | 4.3 | 3 | 2.5 |
| 2 | 5.4 | 3 | 5.0 |
| 3 | 6.4 | 3 | 7.5 |
| 4 | 7.4 | 3 | 10.0 |
| 5 | 8.5 | 3 | 12.5 |
| 6 | 9.5 | 3 | 15.0 |
| 7 | 10.5 | 3 | 17.5 |
| 8 | 11.6 | 3 | 20.0 |
| 9 | 12.6 | 3 | 22.5 |

*Stage lasts two minutes

C—Protocol for Young, Active Subjects (15)

| Stage* | METs | Speed (mph) | % Grade |
|--------|------|-------------|---------|
| 1 | 5 | 1.7 | 10 |
| 2 | 7 | 2.5 | 12 |
| 3 | 9.5 | 3.4 | 14 |
| 4 | 13 | 4.2 | 16 |
| 5 | 16 | 5.0 | 18 |

*Stage lasts three minutes

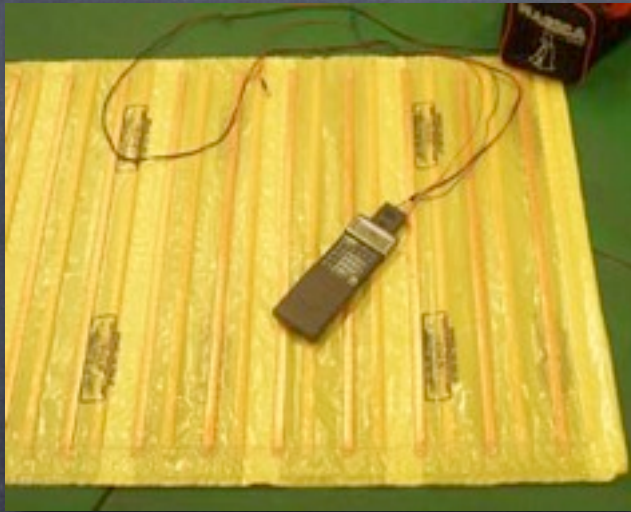
D—Protocol for Very Fit Subjects (7)

| Stage* | METs | Speed (mph) | % Grade |
|--------|-----------|-------------|---------|
| 1 | 12.9/18 | 7/10 | 2.5 |
| 2 | 14.1/19.8 | 7/10 | 5.0 |
| 3 | 15.3/21.5 | 7/10 | 7.5 |
| 4 | 16.5/23.2 | 7/10 | 10.0 |
| 5 | 17.7/24.9 | 7/10 | 12.5 |

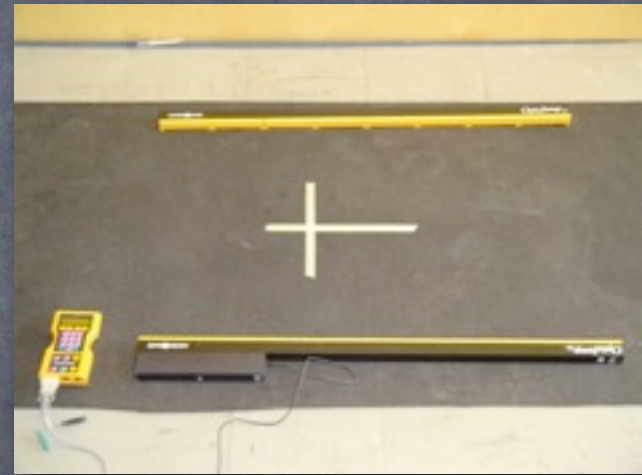
*Stage lasts two minutes; vigorous warm-up precedes test.

60 National Exercise Heart Disease
 11 Standard Balke
 15 Bruce
 7 Åstrand

ErgoJump



OptoJump



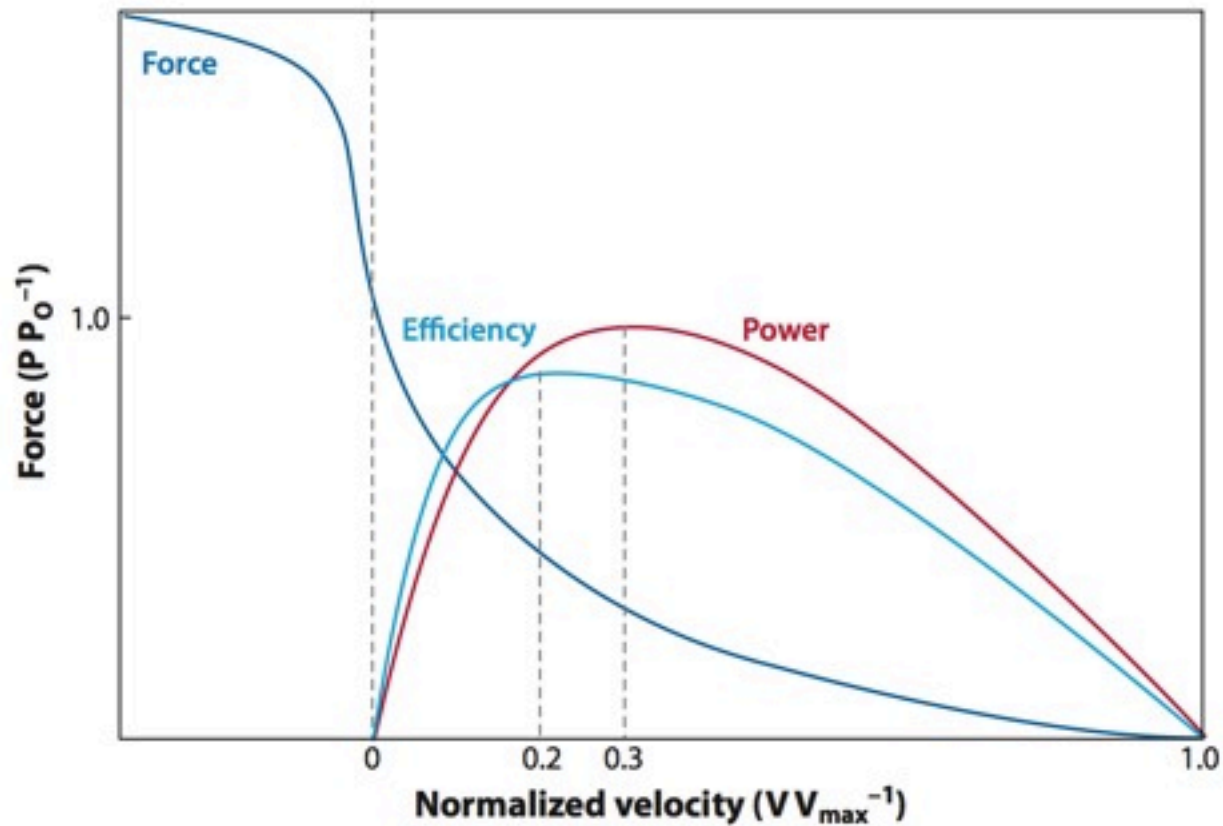


Figure 3

Muscle efficiency (mechanical work output relative to metabolic energy input) and muscle power (the product of muscle force and velocity) vary with shortening velocity. Maximum efficiency is achieved at approximately 20% of the maximal shortening velocity ($0.2 V_{max}$), whereas maximal power is developed at approximately $0.3 V_{max}$. Both efficiency and power are zero when the muscle is contracting isometrically or at its maximal shortening velocity.

Table 15.5 Treadmill Protocols

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| 2 | 3.5 | 2 | 3.5 |
| 3 | 4.5 | 2 | 7.0 |
| 4 | 5.5 | 2 | 10.5 |
| 5 | 6.5 | 2 | 14.0 |
| 6 | 7.5 | 2 | 17.5 |
| 7 | 8.5 | 3 | 12.5 |
| 8 | 9.5 | 3 | 15.0 |
| 9 | 10.5 | 3 | 17.5 |

*Stage lasts three minutes

B—Protocol for Normal, Sedentary Subjects (11)

| Stage* | METs | Speed (mph) | % Grade |
|--------|------|-------------|---------|
| 1 | 4.3 | 3 | 2.5 |
| 2 | 5.4 | 3 | 5.0 |
| 3 | 6.4 | 3 | 7.5 |
| 4 | 7.4 | 3 | 10.0 |
| 5 | 8.5 | 3 | 12.5 |
| 6 | 9.5 | 3 | 15.0 |
| 7 | 10.5 | 3 | 17.5 |
| 8 | 11.6 | 3 | 20.0 |
| 9 | 12.6 | 3 | 22.5 |

*Stage lasts two minutes

C—Protocol for Young, Active Subjects (15)

| Stage* | METs | Speed (mph) | % Grade |
|--------|------|-------------|---------|
| 1 | 5 | 1.7 | 10 |
| 2 | 7 | 2.5 | 12 |
| 3 | 9.5 | 3.4 | 14 |
| 4 | 13 | 4.2 | 16 |
| 5 | 16 | 5.0 | 18 |

*Stage lasts three minutes

D—Protocol for Very Fit Subjects (7)

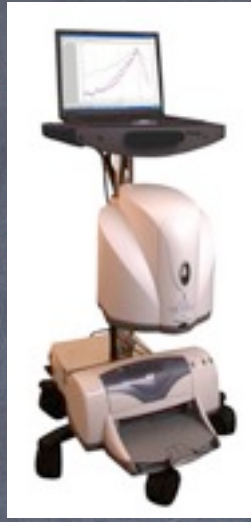
| Stage* | METs | Speed (mph) | % Grade |
|--------|-----------|-------------|---------|
| 1 | 12.9/18 | 7/10 | 2.5 |
| 2 | 14.1/19.8 | 7/10 | 5.0 |
| 3 | 15.3/21.5 | 7/10 | 7.5 |
| 4 | 16.5/23.2 | 7/10 | 10.0 |
| 5 | 17.7/24.9 | 7/10 | 12.5 |

*Stage lasts two minutes; vigorous warm-up precedes test.

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Metabografi

- laboratorio;



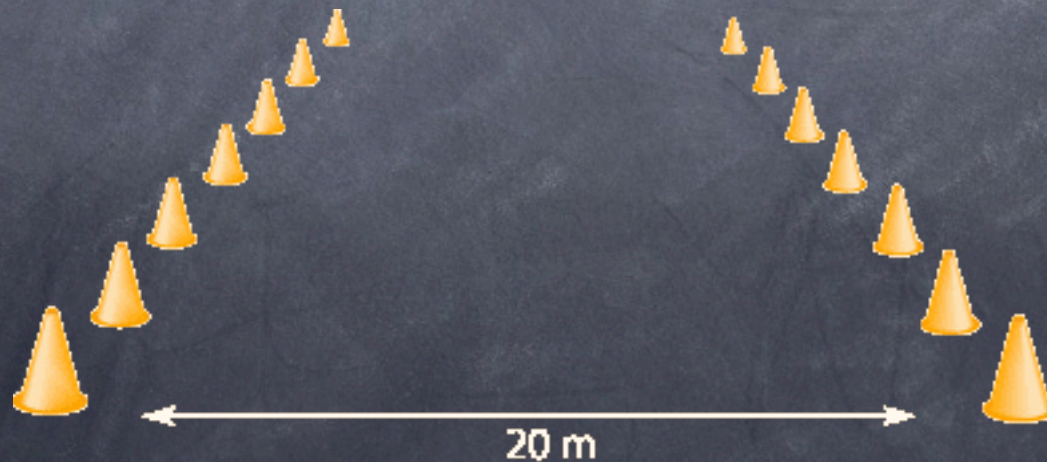
- campo;



Variazioni sul tema

- test di Cooper (Cooper, JAMA 1968): correre il più possibile in 12', $\dot{V}_{O_{2Max}} = (\text{dist. [m]} - 505) / 45$;

- test di Leger (Leger et al., EJAPOP 1982): 'navetta' 20 m, $\dot{V}_{O_{2Max}} = 5.857v_{Max} - 19.458$;



| Stage Met | $\dot{V}O_2$ max (ml · kg · min ⁻¹) | Time (min) | Speed (km · h ⁻¹) | Split time (s/20 m) |
|--------------|--|---------------|----------------------------------|------------------------|
| 7 | 24.5 | 2 | 7.51 2.09 | 9.693 |
| 9 | 31.5 | 4 | 8.70 2.42 | 8.276 |
| 10 | 35.0 | 6 | 9.30 2.58 | 7.744 |
| 11 | 38.5 | 8 | 9.90 2.75 | 7.276 |
| 12 | 42.0 | 10 | 10.49 2.91 | 6.862 |
| 13 | 45.5 | 12 | 11.09 3.08 | 6.492 |
| 14 | 49.0 | 14 | 11.69 3.25 | 6.160 |
| 15 | 52.5 | 16 | 12.29 3.41 | 5.860 |
| 16 | 56.0 | 18 | 12.88 3.58 | 5.589 |
| 17 | 59.5 | 20 | 13.48 3.74 | 5.341 |
| 18 | 63.0 | 22 | 14.08 3.91 | 5.114 |
| 19 | 66.5 | 24 | 14.68 4.08 | 4.906 |
| 20 | 70.0 | 26 | 15.27 4.24 | 4.714 |
| 21 | 73.5 | 28 | 15.87 4.41 | 4.537 |
| 22 | 77.0 | 30 | 16.47 4.58 | 4.372 |
| 23 | 80.5 | 32 | 17.07 4.74 | 4.219 |

Disponibili tirocini, tesi triennale e magistrale (1: 5)

- Recupero corsa in avanti vs. corsa all'indietro;
- bioenergetica della corsa prolungata in pista e su treadmill;
- bioenergetica & biomeccanica della corsa prolungata (MF);
- bioenergetica & biomeccanica dell'in-line skating (MpF);
- bioenergetica & biomeccanica dell'handbiking (PhD p);

Disponibili tirocini, tesi triennale e magistrale (2: 6)

- bioenergetica & biomeccanica dell'handbiking dopo RMET (PhD p);
- bioenergetica & biomeccanica dell'handbiking dopo HIT (PhD p);
- bioenergetica & biomeccanica dopo long bed rest (MF);
- bioenergetica & biomeccanica del nordic running;
- bioenergetica & biomeccanica di vari trekking (MF);
- costo metabolico marcia, corsa, ciclismo e sci di fondo stessi soggetti;

Disponibili tirocini, tesi triennale e magistrale (3: 5)

- costo EMG della marcia (MF);
- frequenza di skipping e costo metabolico della corsa (MpF);
- review dei sistemi di misura portatili dell'attività fisica e del dispendio metabolico (C);
- salto in lungo da fermo con masse aggiunte ed allenamento;
- bioenergetica e biomeccanica della regata velica.