

Work Physiology

Significance

- Safety & health
- Methods evaluation
- Job evaluation
- Rest scheduling
- Job specification
- Employee selection

Metabolism

- Definition

- Transformation: chemical energy \longrightarrow work

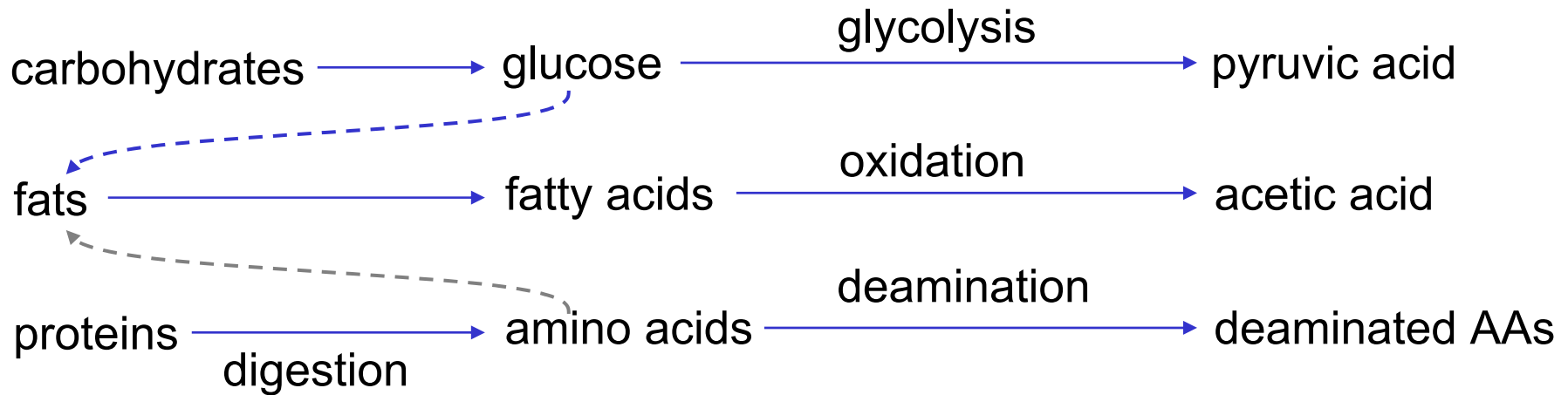
- Units of Measurement

- kilocalorie (kcal)
- 1 kcal = 1000 cal = 1 Cal

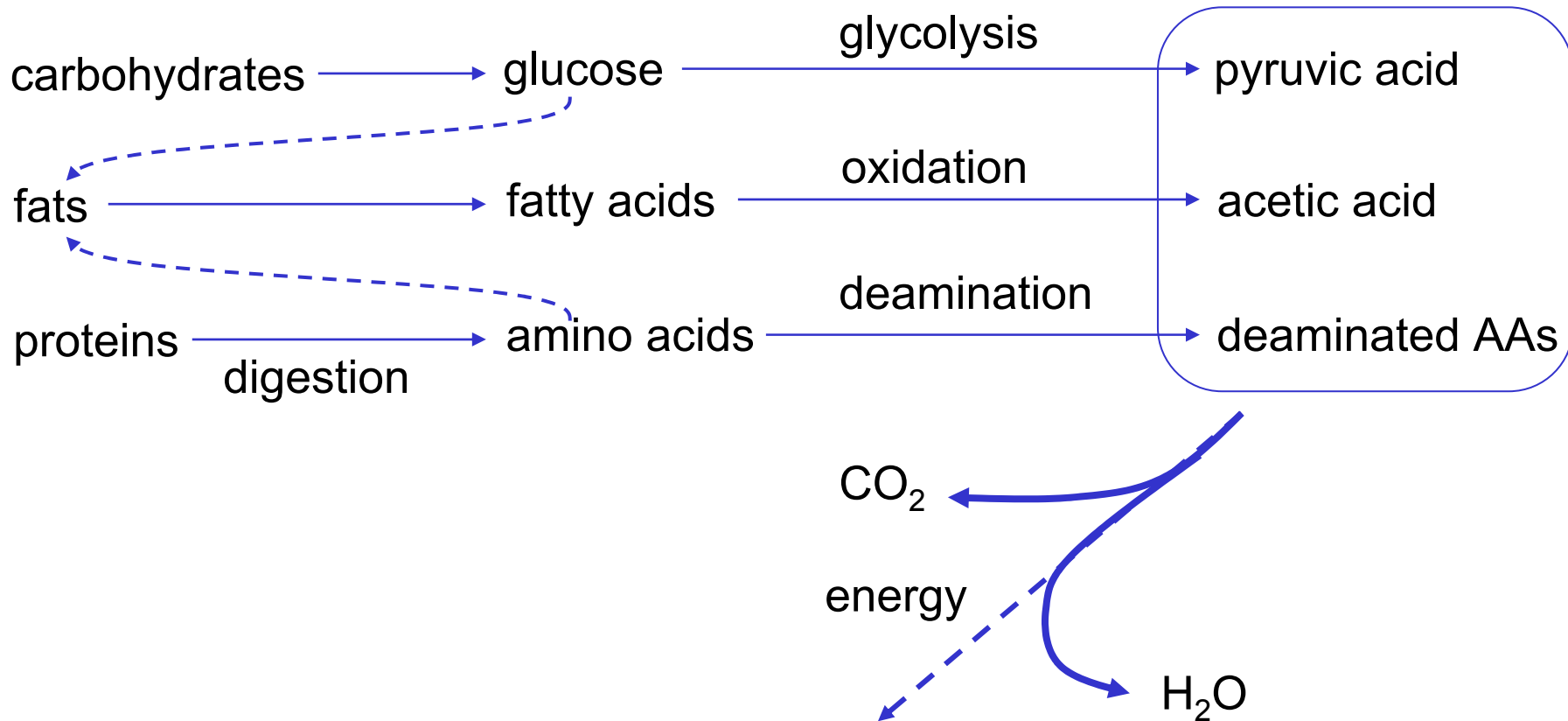
= heat required to raise 1 liter H₂O

15 °C \longrightarrow 16 °C

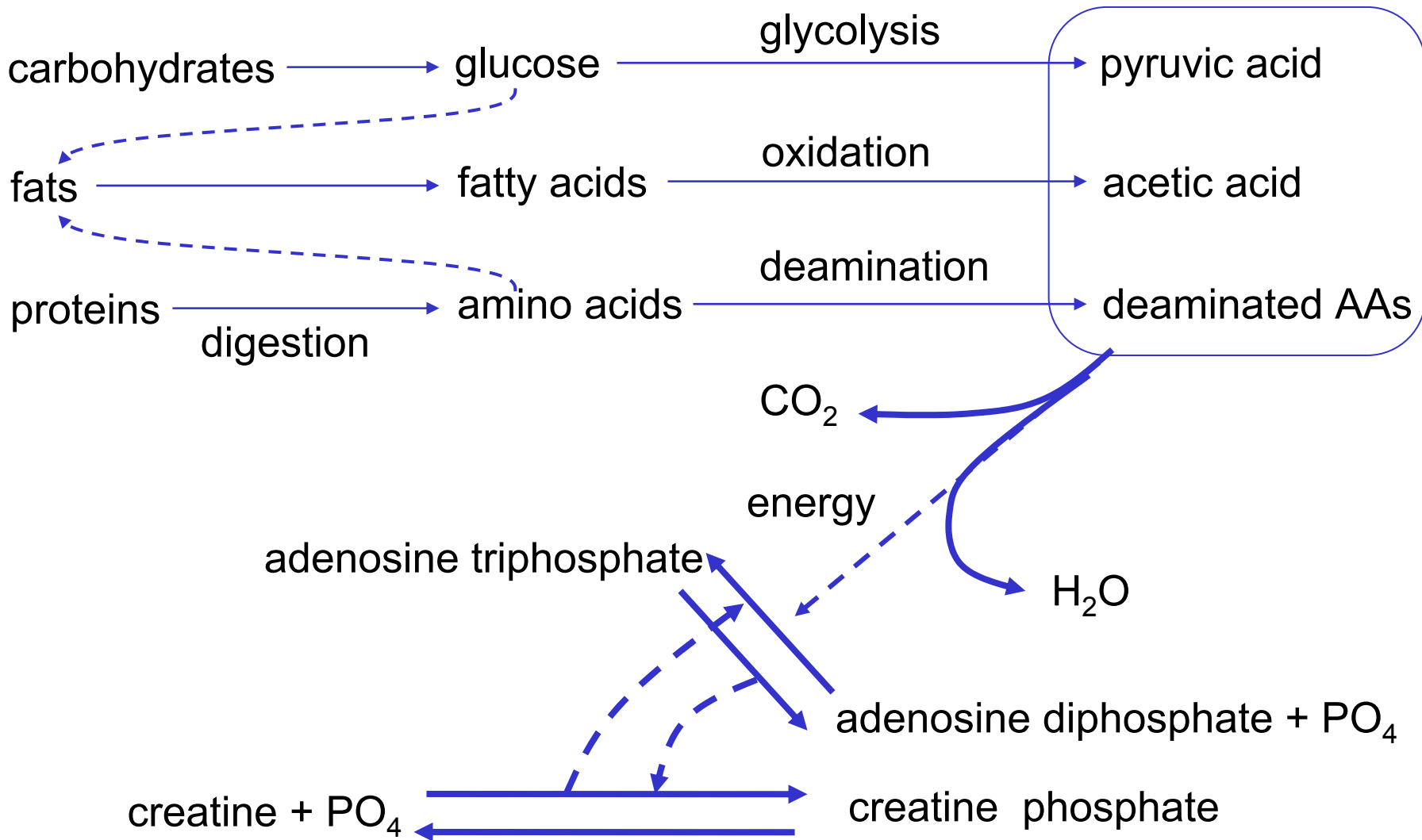
Metabolism (1)



Metabolism (2)



Metabolism (3)



Metabolism: Components

Total Metabolism =

Basal Metabolism (life support)

+

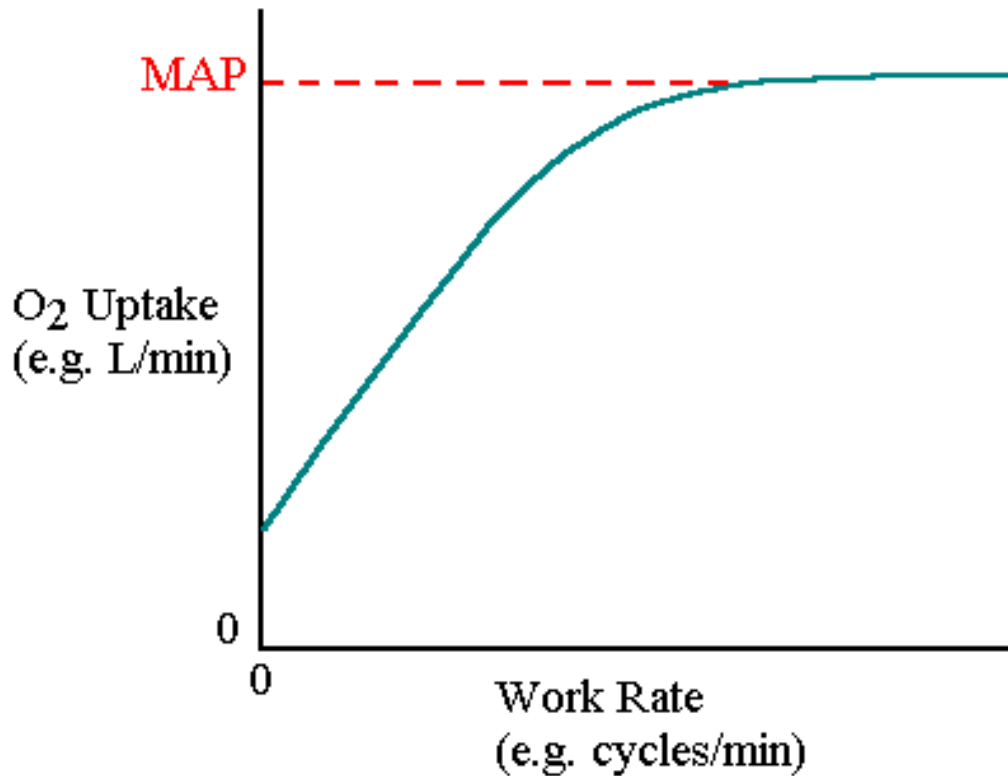
Activity Metabolism (work, leisure)

Basal Metabolism

- Male (70 kg): 1700 kcal/day \cong 1.2 kcal/min
- Female (60 kg): 1400 kcal/day \cong 1.0 kcal/min

- Factors:
 - Gender
 - Size
 - Age

Maximum Aerobic Power (MAP)



Factors affecting MAP

- Age
- Sex
- Heredity
- Physical conditioning

Factors Affecting Energy Expenditure

- Rate of work
- Posture of body
- Method of work

Measurement



- O₂ uptake
- Respiration rate (+ vital capacity)
- Heart rate
- Activity standards

Energy Cost of Work

Type of Work	kcal/min (total met)
light assembly	1.6
medium assembly	2.7
bricklaying	4.0
pushing wheelbarrow (115 lb load)	2.5
sawing wood	6.8
chopping wood	8.0
shoveling (16 lb loads)	8.5
climbing stairs with 17 lb load, suspended	9.0
climbing stairs with 22 lb load on shoulder	16.2

Grades of Physical Work

Grade of work	kcal/min	kcal/day (8 hr)	heart rate (beats/min)	O ₂ (l/min)
rest (sitting)	1.5	<720	60-70	0.3
very light	1.6 - 2.5	768 - 1200	65-75	0.3 - 0.5
light	2.5 - 5.0	1200 - 2400	75 - 100	0.5 - 1.0
moderate	5.0 - 7.5	2400 - 3600	100 - 125	1.0 - 1.5
heavy	7.5 - 10.0	3600 - 4800	125 - 150	1.5 - 2.0
very heavy	10.0 - 12.5	4800 - 6000	150 - 180	2.0 - 2.5
unduly heavy	> 12.5	> 6000	> 180	> 2.5

Recommended Limits

- Energy Expenditure (kcal/min, average)

	<u>8-hour shift</u>	<u>4-hour shift</u>
Male	< 5.00	< 6.25
Female	< 3.35	< 4.20

($< 1/3$ MAP)

- Heart Rate (beats/min, average)

Arm work	≤ 99
Leg work	≤ 112

Rest Requirements

$$R = \frac{T (K - S)}{K - 1.5}$$

R = rest time

T = total working time

K = work metabolic rate

S = standard metabolic rate

Rest Requirements: Example 1

$$T = 60 \text{ min}$$

$$K = 6 \text{ kcal/min}$$

$$S = 4 \text{ kcal/min}$$

$$R = \frac{60 (6-4)}{6 - 1.5} \approx 27 \text{ min}$$

Rest Requirements: Example 2

$$T = 60 \text{ min}$$

$$K = 10 \text{ kcal/min}$$

$$S = 4 \text{ kcal/min}$$

$$R = \frac{60 (10 - 4)}{10 - 1.5} \approx 42 \text{ min}$$