Food fuels and the three energy systems

Chapter 5

pages 115- 123

Session Outline

• Welcome students and session goals	2 mins
• Think, Pair, Share	10 mins
• Food fuels	10 mins
• Energy for physical activity	20 mins
• Wizz Fizz	15 mins
• Homework tasks	3 mins

Thinking through questions pg 117
Vodcast

Where do our muscles get the energy they need for explosive movements such as the spike in volleyball or rapid directional change in Netball?

(Malpeli, Telford, Whittle & Corrie, 2010)

Food fuels

We consume food to provide us with energy to keep going and to refuel our three energy systems.

Our food intake consists of three basic nutrients:

1. Carbohydrates
2. Fats
3. Protein

(Malpeli, Telford, Whittle & Corrie, 2010)

Carbohydrates

The body's preferred source of fuel, particularly during exercise

List some food sources of carbohydrates, for example, bread.

(Malpeli, Telford, Whittle & Corrie, 2010)

Fats

Body's main fuel source at rest and during prolonged sub maximal exercise.

List some food sources of fats, for example, butter.

(Malpeli, Telford, Whittle & Corrie, 2010)

Protein

Negligible contribution to energy in exercise production, mainly used for growth and repair.

List some food sources of protein, for example, fish.

(Malpeli, Telford, Whittle & Corrie, 2010)

table 5.1

Major food types, sources and fuel conversions

Food fuel	Recommended daily intake (RDI) for a balanced diet (%)	Food fuel after conversion/ digestion	Storage
Carbohydrates Sugars and starches such as fruit, cereal, bread, pasta, rice, nuts and vegetables	55–60	Glucose	As glycogen, at the muscles and liver
Fats (triglycerides) Butter, margarine, cheese and full-cream dairy products, oils, nuts, fatty meats	25–30	Free fatty acids (FFAs)	As adipose tissue, at various body sites
Protein Lean meat, fish, poultry, legumes, eggs, lentils, grains, seeds, cheese and other dairy products, seafood	10–15	Amino acids	As muscle, at various body sites

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(Malpeli, Telford, Whittle & Corrie, 2010)

Foods as energy sources

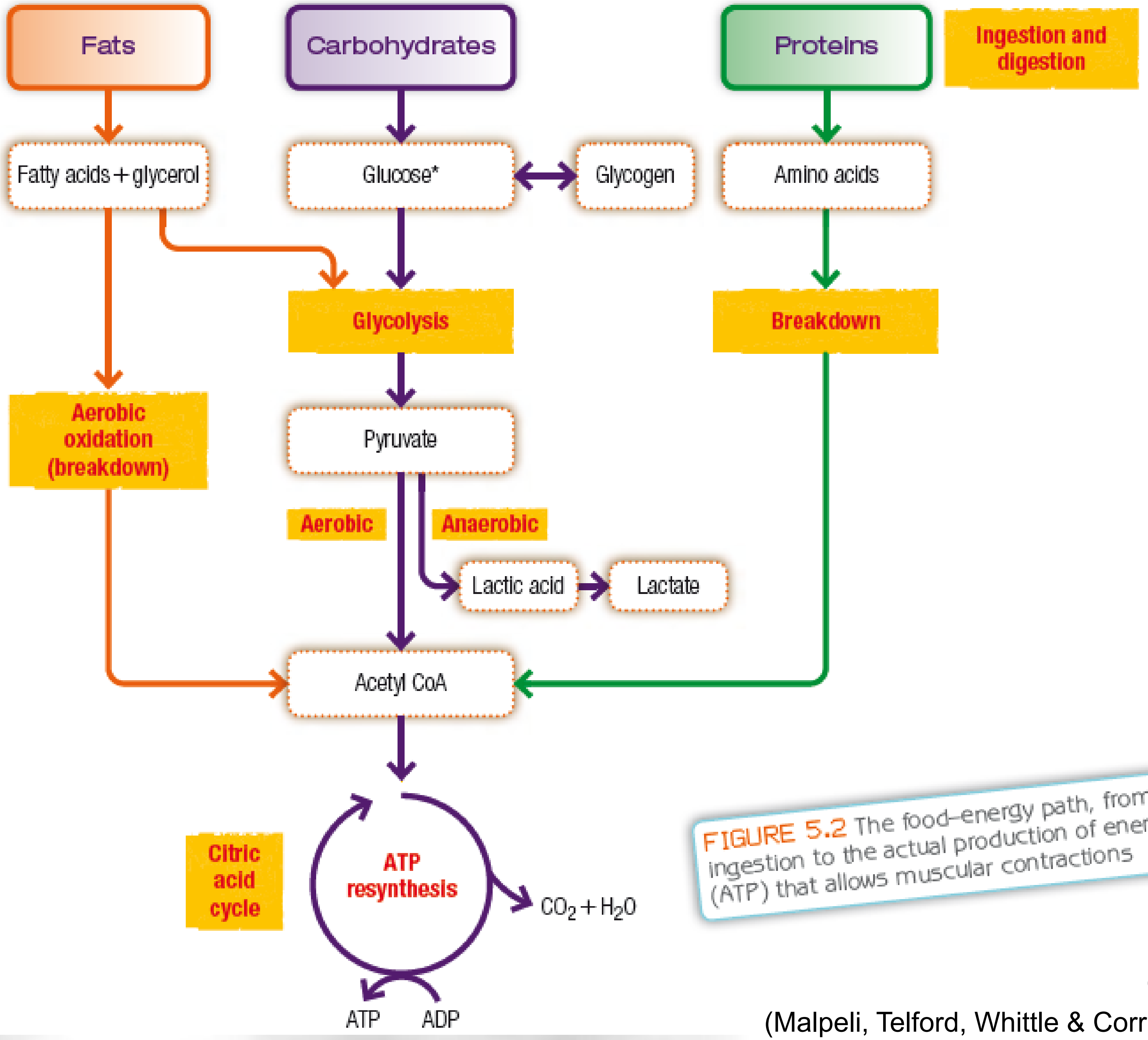

FIGURE 5.2 The food–energy path, from ingestion to the actual production of energy (ATP) that allows muscular contractions

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(Malpeli, Telford, Whittle & Corrie, 2010)

ATP

Adenosine triphosphate (ATP) is a major source of energy that keeps every cell in the body going, including muscles.

a compound made up of adenosine and three phosphate molecules; energy released by its breakdown enables cellular function and muscular movement

(Malpeli, Telford, Whittle & Corrie, 2010)

ATP = Energy

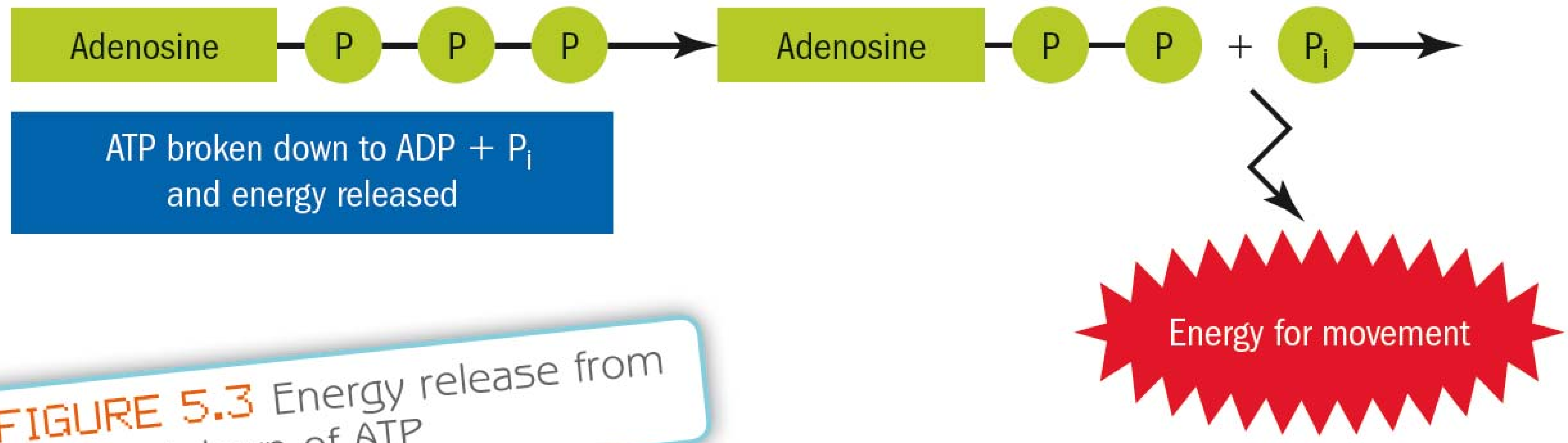

FIGURE 5.3 Energy release from the breakdown of ATP

(pg. 119)

- ATP consists of an adenosine molecule and three phosphate molecules
- When a cell needs energy, it breaks the bond between the second and third phosphate groups, which releases a large amount of energy, forming ADP + P_i
- When the cell has excess energy (from the breakdown of PC or nutrients), it resynthesises ATP from ADP + P_i

(Malpeli, Telford, Whittle & Corrie, 2010)

Fuel Sources for physical activity

Glycogen is the body's preferred energy source in exercise

Energy is produced by glycogen via glycolysis

The breakdown of glycogen either aerobically (with oxygen) or anaerobically (without oxygen) → Each molecule is split into two pyruvic acid molecules and energy is released to form ATP

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Allowing more muscle contractions to occur

<u>Anaerobic glycolysis</u> → breakdown of glycogen with insufficient oxygen, resulting in production of lactic acid, lactate, and hydrogen ions and contributing to fatigue

<u>Aerobic glycolysis</u> → breakdown of glycogen with sufficient oxygen, resulting in the release of 'clean energy' or ATP and carbon dioxide, water and heat

(Malpeli, Telford, Whittle & Corrie, 2010)

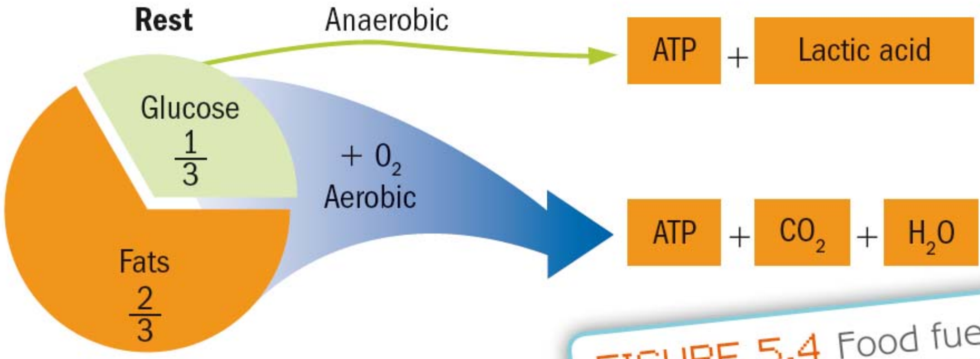

FIGURE 5.4 Food fuel sources at rest

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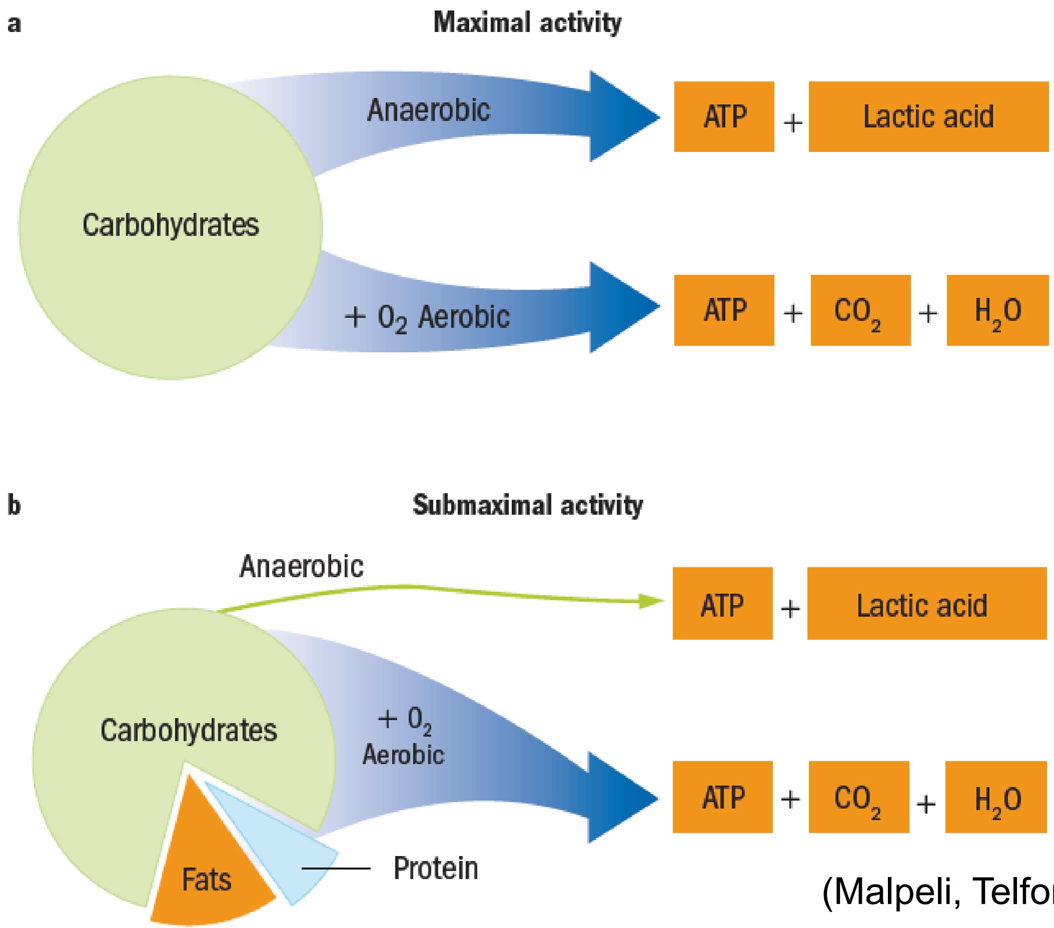

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(Malpeli, Telford, Whittle & Corrie, 2010)

Food Fuels and Energy Production

The practice of increasing carbohydrate stores with the muscles and body by increasing carbohydrate intake and tapering training in the time leading up to major competition

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Carbohydrates

- Varied amounts according to nature of activity
- Prolonged endurance events requires carbohydrate loading
- Anaerobic exercise - CHO is primary source once PC stores are depleted

Fats

- Act as a large energy source
- Fats in the form of triglycerides are stored and can be broken down into FFA, which can be broken down aerobically to provide energy
- Fats become increasingly important when glycogen becomes depleted

Protein

- Forms building blocks for tissue (growth and repair)
- Only used for energy in extreme cases

(Malpeli, Telford, Whittle & Corrie, 2010)

Carbohydrates- fat 'fuel mixture'

As intensity drops from maximal and the duration increases there is an increase in reliance on fats.

Prolonged exercise eg. marathon

- Early stages predominantly use glycogen as a fuel source, however fats are the preferred fuel source under these conditions
- The quicker the athlete can use FFA as a fuel, the greater the capacity of the body to reserve glycogen for later
- As when liver glycogen is depleted, hypoglycaemia can occur

Fats as a fuel source

Aerobic training tends to increase the ability to use fatty acids for ATP resynthesis by increasing the number of mitochondria they develop, and glycogen sparing

A long term adaptation (resulting from aerobic training) that allows fats to be used more readily and earlier during performances; this results in less use of the lactic acid system and allows glycogen to be used much later in performance

(Malpeli, Telford, Whittle & Corrie, 2010)