Energy Systems

Park Centre CYQ

Level 2 Fitness Instructing

www.lesantoine.com

Energy Sources

- All foods digested and absorbed into the blood stream, passed to muscles and cells for immediate use. The three main nutrients are:

- Carbohydrates (Carbs) – Wheat products, Starchy foods, sugars
- Protein – Meats and fish, dairy, nuts, soya
- Fat – found in may foods, inc nuts, seeds, high in dairy and some meats. Saturated fats have no health use, but can be used for energy!

Energy Sources

- Carbs – Glucose stored as glycogen, converted to ATP to be used by muscles
- Fat – fatty acids, stored as adipose (beneath the skin) tissue, and around organs, converted to ATP to be used by muscles
- Protein – Amino acids, growth and repair of tissues. Excess protein will not be stored, but converted to fat and stored in body. Converted to ATP to be used by muscles

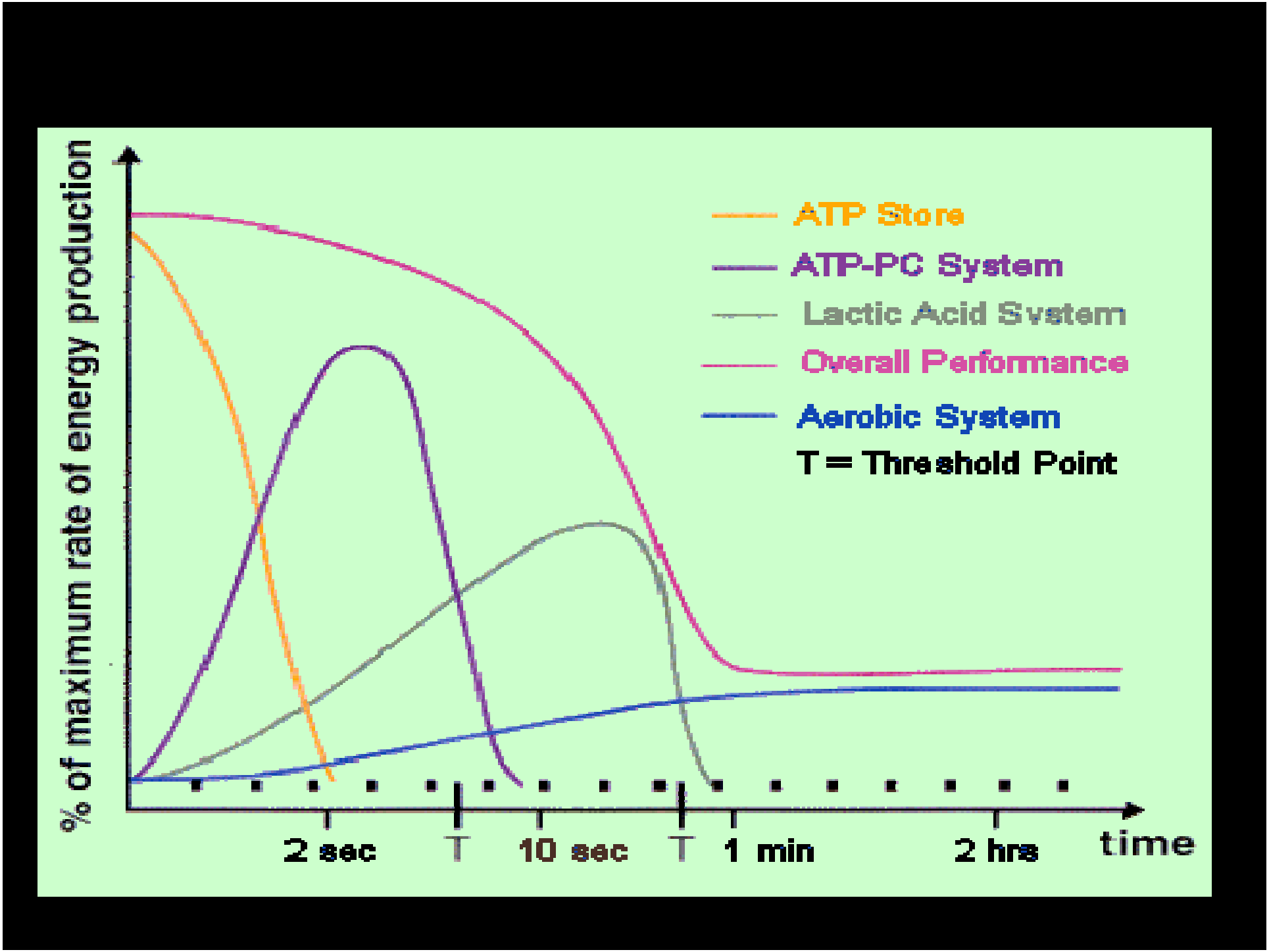
Energy Systems

- Phosphocreatine (PC) system – short bursts of activity, 6 – 10 seconds
- Lactic Acid system (Anaerobic Glycolosis) – high energy activities of 40 – 90 seconds, utilises muscle glycogen, produces lactic acid as a by product
- Aerobic System (Aerobic Glycolosis) – long term low to medium intensity activity, utilising fats and glucose in the presence of oxygen

Energy Systems

- Energy systems do not work in isolation, they all overlap with each other – consider a mile race with a sprint finish!

- Energy systems all work alongside each other, depending on how intense (hard) the current efforts are


% of maximum rate of energy production
ATP Store
ATP-PC System
Lactic Acid System
Overall Performance
Aerobic System
T = Threshold Point
2 sec
T
10 sec
T
1 min
2 hrs
time

Energy Pathways

- Glucose/Fat/Amino Acids –Pyruvate

- Pyruvate into Mitichondria in Muscle cells
- Aerobic Energy = Pyruvate – AcetylCoA and CO_2
- Anaerobic Energy = Pyruvate – AcetylCoA and LA

Energy Stores within the body

- Gylcogen – stored in muscles and liver, approx 100grams in liver, and around 275grams in muscles. Equates to around 1500kcals.
- Fat stores – stored around body, approx 144,000kcals (based on 80k person with 20% bodyfat)
- Protein – no available energy stores. In extreme cases body has to break down (muscle) tissue in order to feed the energy production, a process called **Gluconeogenesis**

Gluconeogenesis

- **gluconeogenesis** /glu·co·neo·gen·e·sis/ (gloo″ko-ne″o-jen´ĕ-sis) the synthesis of glucose from molecules that are not carbohydrates, such as amino and fatty acids.
  Dorland's Medical Dictionary for Health Consumers.

Gluconeogenesis

- The formation of glucose, especially by the liver, from noncarbohydrate sources, such as amino acids. Also called *glyconeogenesis*.The American Heritage® Medical Dictionary

Gluconeogenesis

- Breakdown of Fats, glycerol (fatty acids part broken down to sugars) and amino acids to produce energy during lack of carbohydrates.
- Requires Cortisol (produced by Adrenal Glands during physical/emotional stress)

Protein Breakdown

- Amino Acids can be converted to pyruvate, stored as fat, and excess needs to be ‘treated’ by the body.
- Excess Amino Acids broken down (deanimated) to Keto acids (cand be used to make nonessential Amino Acids) and Ammonia (toxic to blood and brain)
- Liver has to break Ammonia down to Urea
- Kindeys have to break Urea down, with a lot of water, to urine to be passed to bladder
- NOTE OF IMPORTANCE: Prolonged excessive protein intake increases chance of Liver and Kidney damage, which may be irreversible. Big biceps will not help you once this happens!

- Credit:www.thebetterweigh.com/exercise.html

Free Radicals

- All reactions take place in the body with oxygen present. The result of this is that some molecules become unstable or damaged. These are known as Free Radical. They unstable molecule attaches itself to stable cell, thus making that cell unstable too; a chain reaction can continue.
- Free Radicals can damage cell membranes, essential fatty acids, disrupt transport of substances in/out cells, cell proteins disrupting DNA causing mutations

Free Radicals

- Free Radical damage can be caused by:
- Smoking
- Excessive high intensity exercise
- Pollution
- Ultra Violet Radiation

Antioxidants and phytochemicals

- Antioxidants
- Vitamins A C E

- Phytochemicals
- Found in many bright red foods such as tomato, pink grapefruit, watermelon.
- Also found in Soybeans, broccoli, almonds, cranberry, flaxseed and many more veg/fruit/herbs/plants

Exercise Adaptations Aerobic Training

- Increase in mitochondria
- Improved Cholesterol profile
- Increased capillarisation – muscular and CV
- Increased stroke volume and cardiac output – left ventricle gets bigger/stronger
- Reduced Resting Heart Rate (RHR)
- Improved Lung Efficiency
- Increase in blood volume and red blood cells

Exercise Adaptations
Lactic Acid System

(Anaerobic Glycolosis)

- Lactic Acid Training – will develop ability of muscles to work in the presence of a build up of lactic acid by increased
- Increased capillarisation
- Increase in mitochondria
- Increase muscle fibre recruitment

Exercise Adaptations Strength Training

(using phospho-creatine system)

- Extra actin and myosin proteins are laid down during the recovery process resulting in increased muscle size, this is accelerated by testosterone.
- Improved muscle fibre recruitment
- Increased bone density

Examples/Benefits

- Aerobic – cycling, running, swimming, walking, cross country skiing, aerobics classes (ETM)
- Benefits – improved heart and lung function, increased mitichondria (also with Musc End), increase in red blood cells/volume, increased capillaristion, reduced BP, increased bone density

- Anaerobic – weight lifting, throwing and jumping events, sprints
- Benefits – increased laying down of actin and myosin filaments(recovery/nutrition), leading to increased muscle size, increased bone density