Ashford UNIVERSITY℠

HWE 340 EXERCISE AND PHYSIOLOGY

WEEK 2 GUIDANCE

DR. ROXANNE BEHARIE

Ashford UNIVERSITY

ENERGY SYSTEMS

- ATP (Adenosine Triphosphate) is the body's energy currency. It is spent during activities such as exercise.
- ATP supplies both immediate and rapid energy for exercise.
- ATP is very important to the body and requires several systems to create it in the amounts needed for energy expenditure.
- Each type of exercise utilizes different systems and these systems work in phases, or a specific order, in the muscles.

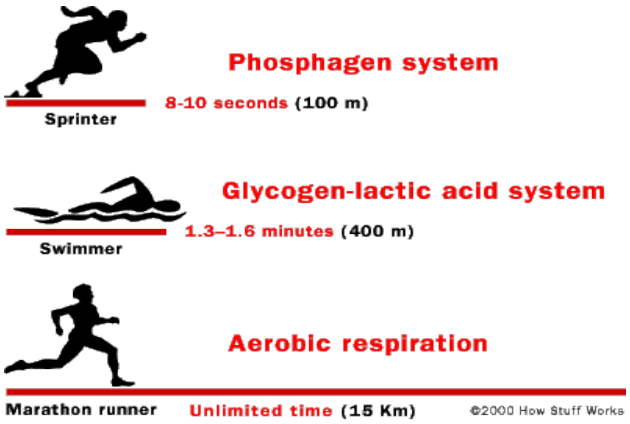


Image retrieved from http://health.howstuffworks.com/wellness/diet-fitness/exercise/sports-physiology4.htm on September 8, 2014.

Ashford UNIVERSITY

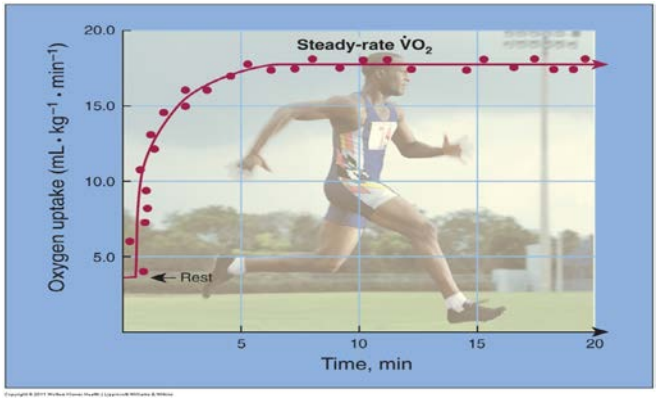
ENERGY SYSTEMS

- The Phosphagen system consists of ATP and creatine phosphate.
  - This system can supply energy to a muscle working at a high rate but only up to 10 seconds (Cheetham, Boobis, Brooks, & Williams, 1986) .
- The Glycogen-Lactic Acid system utilizes the large amounts of glycogen stored in muscles.
  - This process requires approximately 12 chemical reactions and produces ATP at a slower rate than the phosphagen system.
  - This system can produce enough ATP to last approximately 90 seconds (Bean, 2013).
  - The lack of oxygen creates lactic acid which is what makes muscles hurt during and after exercise.
- The Aerobic system requires the presence of oxygen to produce ATP.
  - Carbohydrates will be the first source of energy used since it is the immediately available (Newsholme, Leech & Duester, 1994).
  - Fatty acids from fat reserves in the muscle and body will be the second source of energy. They are energy dense and each triglyceride molecule produces 460 ATP compared to the 36 ATP from a glucose molecule (McArdle, Katch & Katch, 2007).
  - Protein metabolism would be a last resort (e.g. in a starvation situation) and depends on where it enters the metabolic pathway (McArdle, Katch & Katch, 2007). In exercise activities such as marathons, proteins can aid in ATP resynthesis by providing up to 10% of the energy needed (Wardlaw & Hampl, 2007).
  - The aerobic system produces ATP at the slowest rate but as depending on the availability of fuel, it can supply the body with ATP for several hours or longer.

Ashford UNIVERSITY

ENERGY TRANSFER DURING EXERCISE

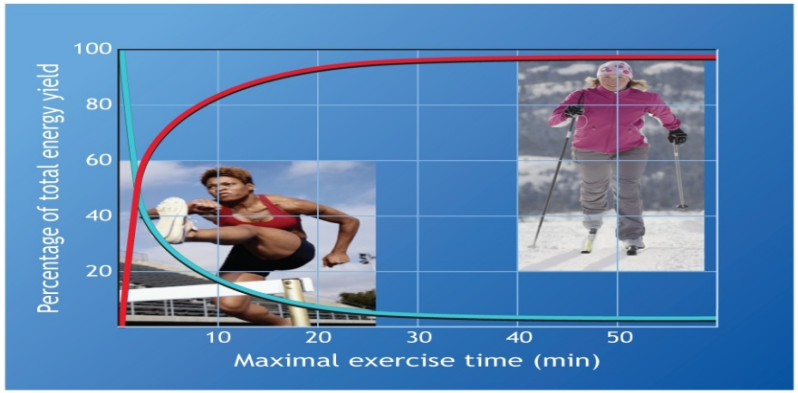
- For a runner, the process is as follows:
  - The ATP lingering in the muscle cells burn off in about 3 seconds.
  - Then the phosphagen system starts up and produces energy to last the next 8 to 10 seconds(Cheetham, Boobis, Brooks, & Williams, 1986) .
    - This would be the major system utilized for short-duration exercises where rapid acceleration is required such as short sprints or weight lifting.
  - For longer distances, the next system to be utilized will be the glycogen-lactic acid system which would produce energy sufficient for a 200- or 400-meter dash.
  - For even longer distances (e.g. a marathon), the body will need oxygen to aid in producing energy and so the aerobic system will come into play.
    - The use of oxygen by cells is called oxygen uptake (VO_2).
    - Oxygen uptake rises rapidly in the first minute of exercise and levels off between minutes 3 and 4 (Dutton, 2012).



Ashford UNIVERSITY

ENERGY SPECTRUM

- Although fats produce more energy per molecule than carbohydrates, carbohydrates have the capacity to transfer energy two times faster than fats and proteins during near-maximum aerobic exercise (Katch, McArdle & Katch, 2011).
- Exercise specialists should consider both the exercise activity (intensity and duration) and the specific energy components required for each exercise activity when developing exercise regimens.



Duration of maximal exercise

	Seconds			Minutes					
	10	30	60	2	4	10	30	60	120
Percentage anaerobic	90	80	70	50	35	15	5	2	1
Percentage aerobic	10	20	30	50	65	85	95	98	99

REFERENCES

1. Bean, A. (2013). The Complete Guide to Sports Nutrition (7th Ed.). London, UK: Bloomsbury Sport.

2. Cheetham, M., Boobis, L., Brooks, S., & Williams, C. (1986). Human Muscle Metabolism During Sprint Running. *Journal of Applied Physiology*; 61(1), 54-60.

3. Dutton, M. (2012). Dutton's Orthopaedic Examination Evaluation and Intervention (3rd Ed.). New York, NY: McGraw Hill Medical.

4. Katch, V., McArdle, W., & Katch, F. (2011). Essentials of Exercise Physiology (4th Ed.). Baltimore, MD: Lippincott Williams & Williams.

5. McArdle, W. D., Katch, F. I. & Katch, V. L. (2007). Exercise physiology: Energy, nutrition, and human performance (6th ed.). United States of America: Lippincott Williams & Wilkins.

6. Newsholme, E., Leech, T. & Duester, G. (1994). Keep on running: The science of training and performance. Great Britain: John Wiley & Sons Ltd.

7. Wardlaw, G. M. & Hampl, J. S. (2007). Perspectives in nutrition (7th ed.). New York, USA: McGraw-Hill.

Ashford UNIVERSITY