Energy Supply & The Effects of Exercise on The Body

Grade 10 - 11
How does our body produce energy?

Digestive system: breaks down food so our cells can use it

Respiratory system: Take oxygen into our body and pushes carbon dioxide out

A lot of ENERGY used during swimming
Introduction

• The muscles of the body needs energy to contract and do all means of movements and this is provided by a substance called Adenosine Triphosphate (ATP).

• This energy is received by the process of respiration which is the release of energy from glucose or other organic chemical in the body.

• The chemical energy in glucose can be used to provide the energy required for growth, repair and movement.

• Energy is released in our body through two main types of respiration:
  1. Aerobic Respiration
  2. Anaerobic Respiration
Aerobic Respiration

- It is the normal form of respiration.
- It requires **oxygen** and releases the most energy from glucose.
- When we breathe like this we have to breathe oxygen in and breathe carbon dioxide out.
- We also have to excrete (get rid of) the extra water in our urine.
Aerobic Exercise

• It refers to exercise that is of moderate intensity.
• It is undertaken for a long duration.
• It refers to the use of oxygen in a muscle’s energy-generating process.
• Many types of exercises are aerobic and by definition are performed at moderate levels of intensity for extended periods.
• It should involve 5 – 10 minutes of warming up at around a 50% intensity.
• Followed by at least 20 minutes of exercise at a more significant rate of intensity (70 – 80 % of maximum heart rate)
• And ending with 5-10 minutes of cooling down at around 50% intensity.
From digestion of food specially carbohydrates

From air breathed In

Into air breathed Out

Left in cell/Blood/Breathed out as Vapour

More efficient than anaerobic respiration

Delivered to cells in blood stream

Removed from cells in blood stream

Used to power all the cell’s processes

C₆H₁₂O₆ + 6O₂ ⇌ 6CO₂ + 6H₂O + ATP

Glucose  Oxygen  Carbon Dioxide  Water  Energy
Anaerobic Respiration

• It also releases energy from glucose but not so much.
• When we breath we produce lactic acid.
• Too much of lactic acid poisons our muscles (you get cramp).
Anaerobic Exercise

• Exercise in which oxygen is used up more quickly than the body is able to replenish it inside the working muscle.

• As a result, muscle fibers have to derive their contractile energy from stored substrates like glycogen, ATP (Adenosine-Triphosphate) and creatine phosphate (CP).

• Weight training/ Long distance running is an example of such an activity.
glucose $\rightarrow$ lactic acid + energy

$C_6H_{12}O_6 \rightarrow 2C_3H_6O_3 + 2$ATP

Broken down by (glycolysis, ATP, CP)
When you jog, ride a bicycle, or walk for an extended period of time your body requires a great deal of oxygen to generate energy.

This is so as those kinds of exercises are aerobic in nature.

Anaerobic exercise occurs under different circumstances.

Under such circumstances (anaerobically), our muscles are unable to receive a sufficient amount of oxygen (our muscles do still get oxygen but not enough to have that drive the energy output).

Thus, our muscles must look to alternative sources to get the energy needed.

The other sources are: Creatine Phosphate/ATP/Glycolysis
During anaerobic exercise, our muscles begin by utilizing stored creatine phosphate to generate the ATP (Adenosine Triphosphate) that produces muscle contraction.

Moment later, ATP energy is made available to muscles.

This is done by metabolizing muscle glycogen into pyruvate through glycolysis, similar to how things happen during the aerobic cycle.

However, instead of being broken down through the slower aerobic process, the pyruvate is fermented to lactic acid.

Lactic acid produced causes pain and fatigue.

Muscles are less efficient and eventually stop working.

Lactic acid is removed by breathing in more oxygen.

This extra oxygen at the end of anaerobic exercise is called oxygen debt (EPOC – Excess Post Exercise Oxygen Consumption)
EPOC is caused by anaerobic exercise, producing lactic acid and requiring high breathing rate after exercise to remove lactic acid.
Video Clip on Anaerobic Respiration
Factors Affecting Recovery Time

- Age
- Gender
- Sleep
- Heat and Cold Contrast Therapy
- Massage Therapy
Age

- Many master athlete will tell you that as we age, we need more recovery time.
- Over 40, we need anywhere from one-to-three days of rest or recovery workouts after a strenuous running session.
- It is up to the individual to decide when to schedule a rest day and when to do light running workouts, to ensure good recovery.
- Older runners should be moderating their running sessions, supplementing or substituting their recovery sessions with cross training activities and allowing more days between stressful running workouts to recover completely.
Gender

• Women tend to take longer to recover from high-stress workouts than men, largely because of hormonal differences.

• Testosterone, the dominant male sex hormone, plays a big role in muscle growth and repair, conferring an advantage to males.
Sleep

• The quality and amount of sleep you get each night contribute significantly to your recovery.

• Good sleep is essential for your body to repair itself mentally and physically.

• Conversely, a chronic (long term) inadequate volume and quality of sleep will impair your recovery.
Heat and Cold Contrast Therapy

- With this technique, you apply heat to your legs from a heat pack, a hot water bottle or hot tub, for two to three minutes, then apply cold (ice cups, cold packs or cold bath) for a similar amount of time.

- This can also be simulated in the shower by flushing hot, then cold, water over the legs and hips.

- This cycle can be repeated two-to-five times.

- Contrast therapy is believed to improve blood flow to the muscles, thus eliminating any lactate lying around, reduce inflammation and reduce delayed onset muscle soreness (DOMS) and provide pain relief.

- Taking a sauna bath is believed to have some recuperative effects.
Massage Therapy

- It is claimed that massage therapy helps heal damaged muscle tissue, improve blood flow to the legs, relax muscle, enhance nutrient and oxygen delivery to muscles, increase removal of lactic acid and improve flexibility of the muscle and connective tissues.

- Research suggests that it is either ineffective or has only limited influence on DOMS, muscle repair and swelling.

- Massage is an often enjoyable and relaxing modality that certainly cannot harm the runner.
Short Term Effect of Exercise on the Energy Supply

<table>
<thead>
<tr>
<th>Heart Rate Increases</th>
<th>During exercise there is an increased in adrenaline which causes the heart rate to quicken.</th>
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<tbody>
<tr>
<td>Breathing Rate Increases</td>
<td>You breathe quicker so as to get more oxygen into the lungs.</td>
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</table>
| Red skin/Heat Control/Sweating | - When we exercise, our muscles are working and they generate heat, so our body temperature rises.  
- Body temperature is regulated by heat radiating from the skin and water evaporating by sweating.  
- When we shiver, our muscles are working to produce heat in order to raise our body temperature.  
- If the conditions are hot, we sweat more and produce less urine.  
- We also lose salt as well as body heat and water. |
| Fatigue | Fatigue in muscles, as ability to use oxygen for the production of energy becomes less efficient. |
| Suffering from Nausea | Feeling light-headed. |
## Long Term Effects of Exercise on the Energy Supply

<table>
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<tr>
<th>Heart Size increases</th>
<th>Our heart gets bigger and stronger and it can supply the same amount of blood with fewer beats.</th>
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<tbody>
<tr>
<td>Resting Pulse Rate (Bradycardia)</td>
<td>Lower resting heart rate and quicker recovery rate.</td>
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<tr>
<td>Stroke Volume Increases</td>
<td>Contracts more powerfully and increase in volume of blood pumped from the heart with each beat.</td>
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<tr>
<td>Ability to tolerate lactic Acid</td>
<td>We can work for longer period harder.</td>
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Test Yourself – Activity One

1. What are the factors affecting your recovery time?
2. How is lactic acid produced?
3. How is energy produced during aerobic activity?
4. Name one effect that long term training will have on a performer’s heart.