Energy Systems

3.1.1 List the macronutrients and micronutrients

- Macronutrients:

  - lipid (fat)
  - carbohydrate
  - protein
  - water

Energy Systems

3.1.1 List the macronutrients and micronutrients

- Micronutrients:

  - vitamins
  - minerals
  - fiber (kind of)

Energy Systems

3.1.2 Outline the roles of macronutrients and micronutrients

- Lipid (Fat)

  - Lipids are an essential part of the diet and are a part of every cell in the body.

  - They provide a concentrated source of energy for the body and assist in the transport of the fat-soluble vitamins (A, D, E & K) to the small intestine for digestion.

  - Cholesterol is an essential ingredient for both male and female and female hormones and also has an important function in healing processes and cell building.

  - Other fats such as essential fatty acids are fundamental to brain and nerve function.

Energy Systems

3.1.2 Outline the roles of macronutrients and micronutrients

- Lipid (Fat)

  - Most people think of this class of macromolecule as 'fats', but these are just one type of lipid of great importance to us, along with oils, phospholipids and steroids.

  - They are a diverse group of macromolecules. Fats and oils differ with respect to whether they are solid or liquid at normal temperatures.

Sewell et.al 2005

Energy Systems

3.1.2 Outline the roles of macronutrients and micronutrients

- Carbohydrate

- In general carbohydrates should form the basis of every meal and snack – because glycogen stores in the muscles provide the energy for performance.

- Muscle glycogen and blood glucose are the fuel used for energy for short-duration, intense, **anaerobic** activities. (fats can't be used during high intensity exercise)

- After all of the stored glycogen and blood glucose have been burnt as fuel during activity, fats become a secondary fuel source.

Browne et al 2000

Energy Systems

3.1.2 Outline the roles of macronutrients and micronutrients

- Protein

- Proteins are made of various combinations of more than twenty amino acids.

- Nine of these amino acids are called "essential" amino acids – because they can't be manufactured by the body, and must be supplied by the diet.

-The major function of amino acids is to make and repair cells of the body. The body breaks down food into amino acids and then makes its own protein.

- Another function of protein is to provide energy in extreme conditions – such as starvation.

Energy Systems

3.1.2 Outline the roles of macronutrients and micronutrients

- Water

  Water is the main component of cells, urine, sweat, and blood, and makes up about two-thirds of total body weight. Water is used for transport and for cooling.

  When fluid is lost, cells become dehydrated and their and their functions are impaired. Cells cannot build tissue or utilize energy efficiently. Urine is not produced and toxins accumulate in the blood. Sweating does not occur and body temperature rises. Blood volume decreases and their less blood to transport oxygen and nutrients.

Browne et.al 2000

3.1.2 Outline the roles of macronutrients and micronutrients

- Vitamins

  - Required for health, and for optimal performance at competitions and training.

  - Deficiencies can lead to early fatigue, infections, illness and slower recovery time from injury.

  - Vitamins are organic compounds that are required in small quantities for normal growth, development, and metabolism.

  - They act as co-enzymes to assist the enzymes that catalyze the breakdown of carbohydrates, proteins, fats and minerals.

3.1.2 Outline the roles of macronutrients and micronutrients

- Vitamins

They are divided into two distinct groups – fat soluble and water soluble vitamins.

Fat soluble are A, D, E and K. They are usually stored in the body, and high levels of these can be toxic.

Water soluble are the B group and Vitamin C. These must be supplied regularly and frequently to the body through diet or supplementation. Because they dissolve in water they are easily expelled from the body.

Browne et. Al 2000

IB
Sports, exercise and health science

Energy Systems

Topic 1
Anatomy

3.1.2 Outline the roles of macronutrients and micronutrients

Sub-topics

1. Nutrition

2. Carbohydrate and fat metabolism

3. Nutrition and energy systems

- Vitamins

The main vitamins needed for athletes are Vitamin C and the B-complex.

Vitamin C is needed for resistance to infection, and for stress management.

B-complex are required for energy metabolism and release.

Browne et. Al 2000

Energy Systems

3.1.2 Outline the roles of macronutrients and micronutrients

- Minerals

Include calcium, potassium, iron, sodium, phosphorus, and chlorine.

- All of these are important in cellular functions such as muscle contraction, fluid balance and energy systems.

Deficiencies in certain minerals can sometimes impede athletic performance. For example, female athletes might find it necessary to take iron supplements during heavy training

Browne et. Al 2000

Energy Systems

3.1.2 Outline the roles of macronutrients and micronutrients

- Fiber

Fiber is the part of the plant that can not be digested by the body.

Moderate amounts of fiber promote:

  - a slower rise in glucose level.
  - a lower insulin requirement
  - normal bowel function and reduced chance of constipation
  - lower cholesterol levels.

http://www.novonordisk.ca/documents/article_page/document/role_of_fibre.asp

Energy Systems

3.1.3 State the chemical composition of a glucose molecule

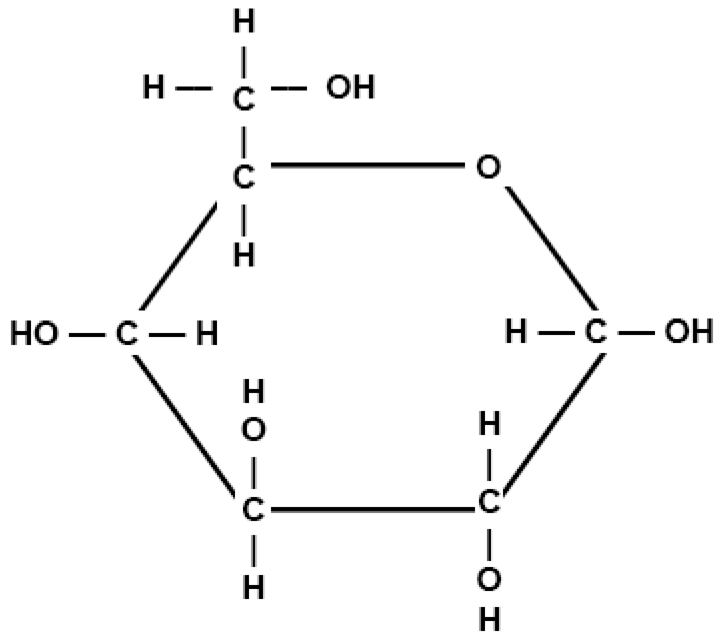
Glucose is an example of a carbohydrate which is commonly encountered. It is also known as blood sugar, and dextrose.

Its chemical formula is C6 H12 O6, and this empirical formula is shared by other sugars - called hexoses - 6 carbon sugars. This chemical composition is a 1:2:1 ratio.

http://www.biotopics.co.uk/as/glucose2.html

Energy Systems

3.1.4 Draw a diagram representing the basic structure of a glucose molecule



http://www.crsbooks.net/images/c1.gif

Energy Systems

3.1.5 Explain how glucose molecules can combine to form disaccharides and polysaccharides

Many of the most important carbohydrates are the more complex disaccharide and polysaccharides rather than the simpler monosaccharides.

http://www.3rd1000.com/chem301/chem302o.htm

3.1.5 Explain how glucose molecules can combine to form disaccharides and polysaccharides

Disaccharides

When two monosaccharide molecules react or condense with each other, losing a water molecule in the process, the product is a disaccharide. Several disaccharides are common in nature, the most well-known being sucrose. Sucrose is also called cane sugar, beet sugar, table sugar, and dextrose. Sucrose is a disaccharide of glucose and fructose.

http://www.3rd1000.com/chem301/chem302o.htm

Energy Systems

3.1.5 Explain how glucose molecules can combine to form disaccharides and polysaccharides

Disaccharides will react with water, especially in the presence of enzymes such as those supplied by honeybees, to form invert sugar. Invert sugar is a mixture of the two monosaccharides and is responsible for the sweet taste of honey.

Energy Systems

3.1.5 Explain how glucose molecules can combine to form disaccharides and polysaccharides

Monosaccharides can undergo a series of condensation reactions, adding one unit after another to the chain until very large molecules (polysaccharides) are formed. This is called **condensation polymerization**, and the building blocks are called **monomers**.

http://www.chemsoc.org/networks/learnnet/cfb/carbohydrates.htm

Energy Systems

3.1.5 Explain how glucose molecules can combine to form disaccharides and polysaccharides

Polysaccharides

A polysaccharide is a polymer of one of the monosaccharides. All of the well-known polysaccharides found in nature are polymers of glucose.

Several familiar materials are polymers of glucose: starch, which is poly-alpha-glucose; cellulose, which is poly-beta-glucose; and glycogen, which is a differently branched form of poly-alpha-glucose.

http://www.3rd1000.com/chem301/chem302o.htm

Energy Systems

3.1.5 Explain how glucose molecules can combine to form disaccharides and polysaccharides

Polysaccharides

Cellulose is used to form plant structures since it is not soluble in water, while plants use starch for energy storage.

Animals store energy as glycogen or, for longer-term storage, convert glycogen and other carbohydrates to lipids.

http://www.3rd1000.com/chem301/chem302o.htm

3.1.6 State the composition of a molecule of triacylglycerol (TAG)

Triacylglycerols (pretty much just a triglyceride) are storage lipids stored mostly in adipose (fat) cells and tissues, which are highly concentrated stores of metabolic energy.

As the name triacyglycerols implies the molecules are composed of three Fatty Acids attached to a glycerol skeleton. (Glycerol is a central component of lipids)

TAG is the preferred form for energy storage because Fatty Acids have greater potential chemical energy due to having more CH groups than does glucose, which is already partly oxidized (more oxygen molecules) with plenty of OH groups.

http://www-biol.paisley.ac.uk/Courses/stfunmac/glossary/triacylglycerol.html

Energy Systems

3.1.7 Distinguish between saturated and unsaturated fatty acids

A fatty acid is a carboxylic acid (an organic compound that contains a carboxyl group -COOH), which is either saturated or unsaturated.

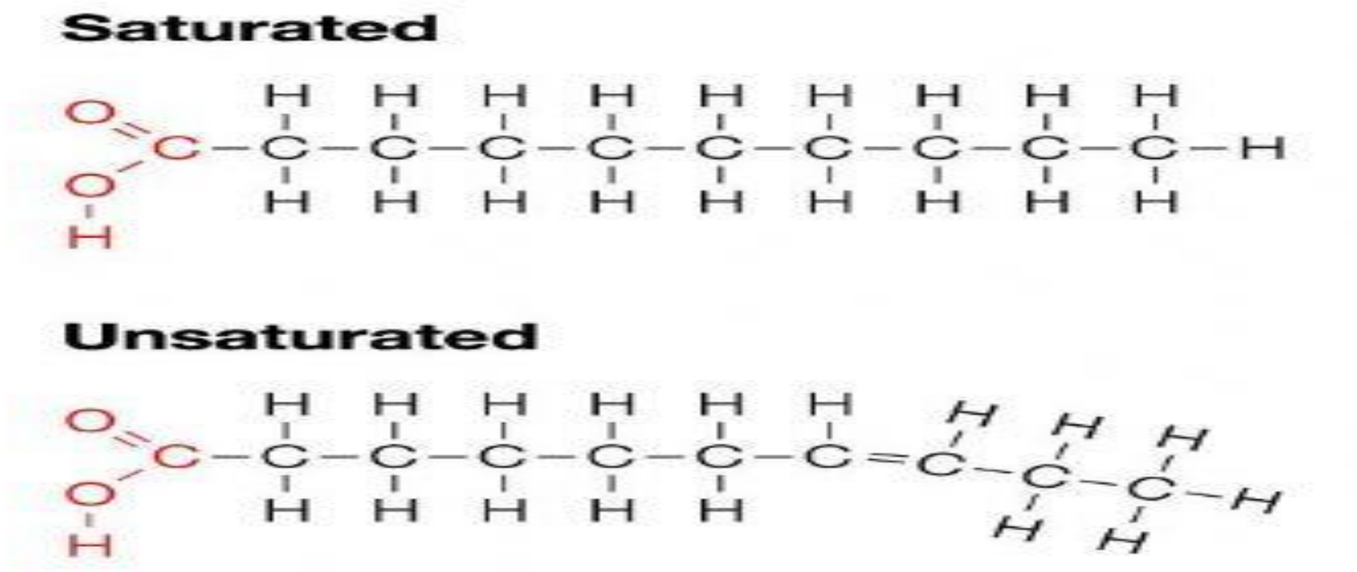
Most of the natural fatty acids have an even number of carbon atoms, because there biosynthesis involves acetyl-CoA, an enzyme that has two carbon atoms that helps break down fatty acids.

http://en.wikipedia.org/wiki/Fatty_acid

Energy Systems

3.1.7 Distinguish between saturated and unsaturated fatty acids

- Saturated fats have no double bonds between their carbon atoms and tend to be solid at room temperature.
-Whereas unsaturated fats (one or more double bonds) are liquid at room temperature and therefore considered oils.



3.1.7 Distinguish between saturated and unsaturated fatty acids

Saturated Fatty Acids

The term "saturated" refers to hydrogen, in that all carbons contain as may hydrogens as possible.

Saturated fatty acids form straight chains and, as a result, can be packed together very tightly, allowing living organisms to store energy very densely.

Foods that contain a high proportion of saturated fat include butter, coconut oil and dairy products. Diets high in saturated fats are correlated with an increased incidence of atherosclerosis and coronary heart disease.

http://en.wikipedia.org/wiki/Saturated_fat

3.1.7 Distinguish between saturated and unsaturated fatty acids

Unsaturated Fatty Acids

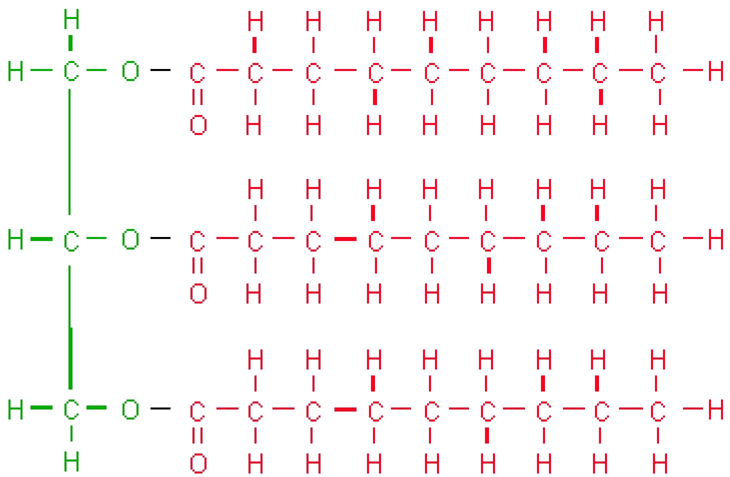
In cellular metabolism hydrogen-carbon bonds are broken down (or oxidised) to produce energy, thus an unsaturated fat molecule contains somewhat less energy (less kilojoules) than a comparable sized saturated fat.

Foods containing unsaturated fats include avocado, nuts and vegetable oils, such as soy bean canola and olive oils.

Although, unsaturated fats are healthier than saturated fats their consumption should still be limited.

http://en.wikipedia.org/wiki/Unsaturated_fat

3.1.8 Draw a diagram representing the basic structure of a lipid molecule



Energy Systems

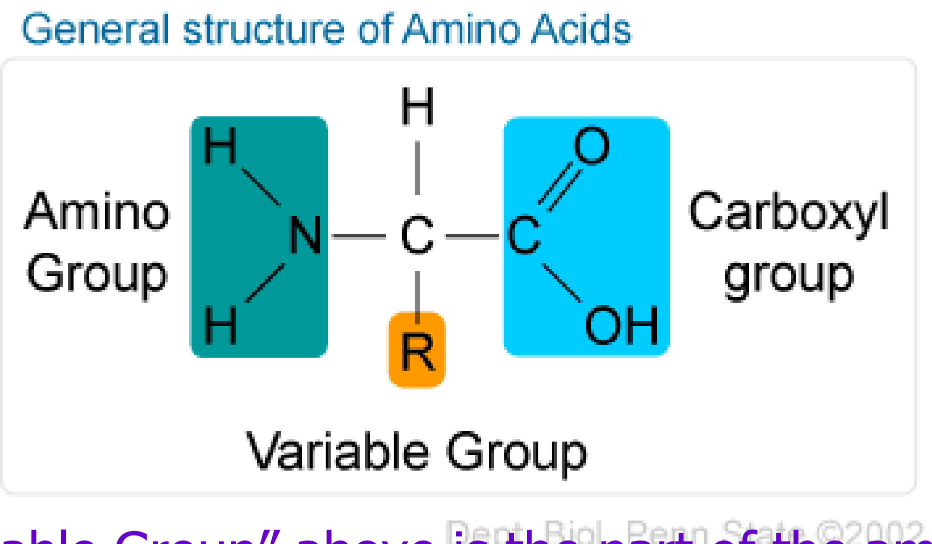
3.1.9 State the chemical composition of a protein molecule

Proteins are the most complex and functionally diverse of molecules of living organisms. They compose enzymes, blood and muscle tissue just to name a few and are therefore associated with meat products.

The base elements of proteins are C, H, O and N. The monomers of proteins are 20 different amino acids.

Energy Systems

3.1.10 Draw a diagram representing the basic structure of an amino acid



The "Variable Group" above is the part of the amino acid structure that makes each of the 20 amino acids unique. The amino group and carboxyl group are uniform among all amino acids.

3.1.11 Distinguish between an essential and a non-essential amino acid

Amino acids are the chemical units or building blocks that make up protein. Every living organism is composed of protein and it is vital in the chemical processes that sustain life.

In addition to combining to form the body's proteins, some amino acids act as neurotransmitters or precursors of transmitters, the chemicals that carry information from one nerve cell to another.

http://www.becomehealthynow.com/article/proteins/335/

Energy Systems

3.1.11 Distinguish between an essential and a non-essential amino acid

There are approximately twenty amino acids encoded by the universal genetic code that are combined in various ways to create more than 40,000 proteins known so far to science.

The essential amino acids are those that the body cannot synthesize in sufficient quantities to satisfy the nutritional requirements for good health and that they must be included in the diet.

Energy Systems

3.1.11 Distinguish between an essential and a non-essential amino acid

The nine essential amino acids are HISTIDINE, ISOLEUCINE, LEUCINE, LYSINE, METHIONINE, PHENYLALANINE, THREONINE, TRYPTOPHAN and VALINE

Their best sources are meat, fish, fowl, eggs and dairy products.

3.1.11 Distinguish between an essential and a non-essential amino acid

In addition, CYSTEINE (cystine) and TYROSINE, sometimes classified as NONESSENTIAL AMINO ACIDS, are now considered semiessential because if the diet contains them (meat, milk, fish, poultry and legumes are good sources), the body can use them in place of two essential amino acids methionine and phenylalanine, respectively to make protein.

The nonessential amino acids are ALANINE, ARGININE, ASPARAGINE, ASPARTIC ACID, GLUTAMIC ACID, GLUTAMINE, GLYCINE, PROLINE, SERINE and TAURINE.

3.1.12 Describe current recommendations for a healthy balanced diet

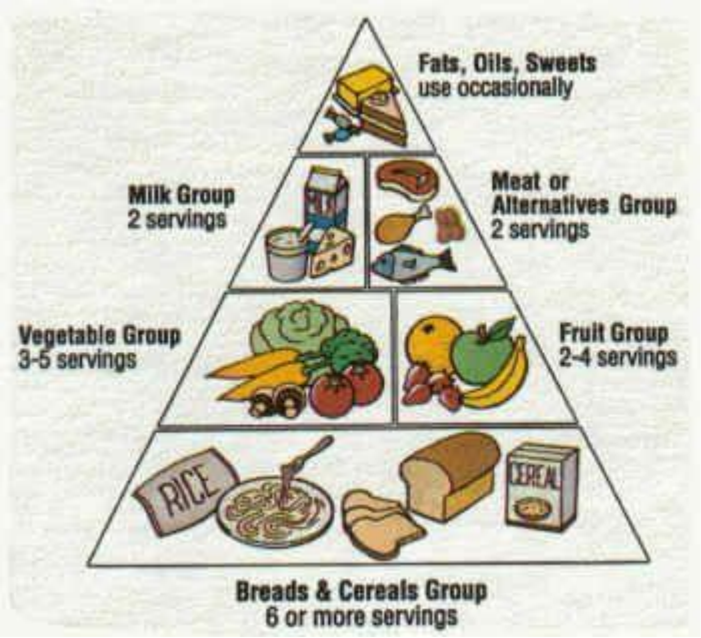
Analyze the website below and describe the nature of a healthy balanced diet.

Consider recommendations for carbohydrates, proteins, lipids (mono, poly and saturated), fiber, water and salt for adults in general population.

http://www.abc.net.au/health/library/stories/2007/04/25/1906038.htm

Energy Systems

3.1.12 Describe current recommendations for a healthy balanced diet



http://www.sciencepages.co.uk/keystage3/year8/module13/images/foodpyramid.jpg

Energy Systems

3.1.12 Describe current recommendations for a healthy balanced diet

International Dimension: Consider socio-cultural influences of food selection and preparation that exist across populations.

Mediterranean diet

http://www.foodpyramid.com/food-pyramids/mediterranean-diet-pyramid/

3.1.12 Describe current recommendations for a healthy balanced diet

International Dimension: Consider socio-cultural influences of food selection and preparation that exist across populations.

Japanese diet

http://pogogi.com/japanese-diet-understanding-japanese-food-pyramid

Energy Systems

3.1.13 State the energy content per 100g of carbohydrate, lipid and protein.

Energy content per 100g:

Carbohydrate	1600kJ
Lipid	3700kJ
Protein	1700kJ

Which would release the most heat if burned?

Energy Systems

3.1.13 State the energy content per 100g of carbohydrate, lipid and protein.

Research Task: Consider the implications these energy values will have if consuming a diet based on junk food.

http://nutrition.mcdonalds.com/usnutritionexchange/nutritionfacts.pdf

Energy Systems

3.1.14 Discuss how the recommended energy distribution of dietary macronutrients differs between endurance athletes and non-athletes.

The quality of the athletes diet is assessed primarily in terms of the macronutrients (carbohydrates, proteins, fats).

Micronutrients, such as vitamins and minerals, are essential, but do not provide energy.

Ruskin et.al 2007

Energy Systems

3.1.14 Discuss how the recommended energy distribution of dietary macronutrients differs between endurance athletes and non-athletes.

Sedentary people should consume a diet that has approximately 55-60% carbohydrates, no more than 30% fat and 10-15% protein.

The endurance athlete requires additional carbohydrates, which may comprise up to 60-70% of the diet. The increase should be at the expense of fat.

Ruskin et.al 2007

Energy Systems

3.1.14 Discuss how the recommended energy distribution of dietary macronutrients differs between endurance athletes and non-athletes.

Athletes who train heavily on successive days, such as endurance runners and swimmers must be aware of the need for carbohydrate replenishment to avoid feeling "flat".

While replenishment of liver glycogen is reasonably rapid, muscle glycogen stores take 24 hours to restore.

Ruskin et.al 2007

IB

Sports, exercise and health science

Energy Systems

Topic 1
Anatomy

Sub-topics

1. Nutrition

2. Carbohydrate and fat metabolism

3. Nutrition and energy systems

3.1.14 Discuss how the recommended energy distribution of dietary macronutrients differs between endurance athletes and non-athletes.

http://www.bonappetit.com/entertaining-style/trends-news/article/seth-weil-olympic-diet

Energy Systems

3.1.14 Discuss how the recommended energy distribution of dietary macronutrients differs between endurance athletes and non-athletes.

Research Task: Using the reference below outline the dietary requirements of endurance athletes.

http://www.ausport.gov.au/__data/assets/pdf_file/0007/143386/CurrentConcepts.pdf