

Animal Nutrition

A balanced diet

- A balanced diet provides an adequate intake of biological molecules and energy needed to sustain the body and ensure good health and growth

A balanced diet consists of:

Carbohydrates, proteins, fats, vitamins, minerals, water and fibre.

Each of these carries out one or more of three basic functions:

- To provide energy- this is mainly the role of carbohydrates and fats. Proteins are used for energy only if they are in excess of requirements for growth, development, repair and replacement
- To allow growth and repair of body cells and tissues. Proteins in the diet provide a source of amino acids for cells to make their own proteins
- To regulate the body's metabolism

The energy required for body functions is known as the basal metabolic rate (BMR), which varies from person to person. (Adults require approx. 7000kJ/day.)

Diet depends on age, sex and activity levels

- Children have a greater energy requirement than adults because they have a higher BMR, because they are more active and are still developing
- Elderly have a lower BMR, they have a lower energy and protein need. However, they still need to eat a healthy diet to remain healthy.
- Women have a higher fat content than men, fat tissues has a lower BMR than muscle, so women generally have a lower energy requirement as compared to men.
- The energy needs of occupation that involve physical activity are greater than less active jobs.
- Women need extra nutrients when they are pregnant and when they are breastfeeding.

Why is fat bad for us?

- Fat is a more efficient store of energy than carbs

Two main types of fat:

1. Saturated fat comes from animals
 2. Unsaturated fat that comes from fish and plants
- Saturated fat in the diet leads to an increase in cholesterol. High fat diets tend to increase the risk of producing more cholesterol and having a high concentration in the blood.
 - High concentrations of cholesterol leads to the narrowing of arteries and risk of developing high blood pressure and heart disease.

Two types of unsaturated fat:

1. Monounsaturated fats have little effect on blood cholesterol
2. Polyunsaturated fats reduce cholesterol concentration which reduces heart disease

Sources of nutrients

<u>Food group</u>	<u>Good Sources</u>	<u>Role in body</u>
Carbohydrates (sugars and starches)	Rice, potatoes, bread, yams, sugar and honey	<ul style="list-style-type: none">• Simple sugar = immediate source of energy. Energy as a result of respiration
Proteins	Meat, fish, milk and nuts	<ul style="list-style-type: none">• Develops new cells i.e. growth and repair• Can be respired producing energy
Fats	Butter, cheese, fat in meat, fat in fish and nuts	<ul style="list-style-type: none">• Long term store of energy• Produce twice as much energy as protein and carbohydrates• Thermal insulators• Buoyancy to marine animals
Water		<ul style="list-style-type: none">• The body cannot survive without water• Needed for chemical reactions to take place• Blood transports minerals dissolved in water• Waste materials is passed out in solution (Urine and Sweat)• Water in sweat cools us down• Makes up majority of blood volume
Fibre	Bran-cereals, sweetcorn, celery and cabbage	<ul style="list-style-type: none">• Made from cellulose from plant cell walls• Adds bulk to our food• Helps food pass down the gut• Prevents constipation• Absorbs poisonous bacteria• Lowers cholesterol• Reduces risk of heart disease and bowel cancer

Vitamins and minerals

<u>Name</u>	<u>Rich food source</u>	<u>Use in Body</u>	<u>Deficiency symptoms (diseases)</u>
Vitamin C	Oranges, lemons, citrus fruit	Tissue repair; resistance to disease	Bleeding gums (scurvy)
Vitamin D	Fish oil, milk, butter, sun	Strengthens bones and teeth	Soft bones, legs bow outwards (rickets)
Iron	Liver, meat, cocoa, eggs	Formation of haemoglobin in red blood cells for transport of oxygen	Tiredness, lack of energy (anaemia)
Calcium	Milk, fish, green vegetables	Strengthens bones and teeth	Weak, brittle bones and teeth (rickets), muscles weakness and cramps

Balancing energy needs

- When eating too much, your energy intake is greater than your energy output which leads to an increase in fat and body mass
- To be obese, means to be severely overweight
- Obesity is caused by:
 - i. High intake of fatty and refined foods containing a lot of added sugar
 - ii. Too little exercise
 - iii. Social and emotional stress, 'comfort eating'
- Health problems associated with being overweight:
 - i. Heart disease
 - ii. High blood pressure
 - iii. Type 2 Diabetes
 - iv. Arthritis

Identification of obesity

- Being above 20% of recommended weight for his or her height
- Having a BMI greater than 30

$$\text{Body Mass Index} = \frac{\text{body mass/kg}}{\text{height/meters}^2}$$

BMI	Classification
Less than 20	Underweight
Between 20-24	Normal
25-30	Overweight
More than 30	Obese
More than 40	Severely obese

Constipation

- Constipation is caused by the lack of fibre or roughage in the diet. Fibre helps with the movement of down the alimentary canal
- Soft foods do not instigate peristalsis as much as harder indigestible food
- If the movement of food is slow, it will result in constipation and difficulty to defecate
- Fruit and vegetables relieve constipation

Weight loss

- Eat less high energy foods (lower energy intake)
- Do more exercise (increase energy output)
- Combine balanced diet with lower energy intake
- Gradually increase exercise
- Have an ideal but achievable weight loss goal
- Have a positive self-image, be realistic
- Do not attempt a diet which eliminates a food group

Starvation and nutrient deficiency

- Starvation results in a very low body mass with lack of fat and muscle wasting, and a lack of resistance to infections

- In terms of an inadequate diet, starvation is caused by the drawing up upon stores of carbohydrates, fat and proteins for energy, however, water is not stored. The BMR is reduced, and the body begins to break down proteins in muscles as a source of energy
- During starvation there are deficiencies of protective vitamins; people are at risk of developing infectious diseases
- Malnourishment is caused by: contaminated water, poverty, malaria, social unrest/war, poor harvest/drought
- The most common form of undernutrition is protein energy malnutrition (PEM)

Nutritional Marasmus

- Protein deficiency
- Severe wasting, extreme thinness
- Skin on upper arms, legs and buttocks may appear baggy
- Sufferer may be too weak to walk or sit
- Stomach muscles may stick out because muscles are weak and there may be gas in the upper gut caused by parasites or infection
- Heart and other organs will be extremely weak

Kwashiorkor

- Protein deficiency
- Occurs between ages 1 and 3 years
- Growth failure, low weight, oedema (swelling) feet, legs, face and hands
- Wasted muscles
- Misery and apathy
- Hair turns orangeish, straightens out and pulls out easily
- Skin becomes lighter on the face
- Stools are loose
- Anaemia
- Flaky skin, which may lead to ulcers and gangrene

The above may be brought upon by living conditions and being displaced by the breast by the next child and given a low protein porridge diet (cassava and plantain). Can be brought on by infection (HIV, malaria, cholera, diarrhoea)

With both marasmus and kwashiorkor increasing food intake should be managed carefully to prevent too much strain on the body

Vitamin C deficiency

- Scurvy (Bleeding Gums)
- Vitamin C helps bond together cells and helps the use of calcium by the bones and teeth. Vitamin C is used to make skin, tendons, ligaments and blood vessels. It also helps with healing of wounds and the formation of scar tissues
- Lack of Vitamin C leads to areas of bruising and swelling of bone joints

Vitamin D

- Needed for the absorption of calcium, and regulation of deposition of calcium in bone cells
- Deficiency causes rickets

- Bones fail to grow properly and become soft, so when children start walking the bones bend with the weight of the body
- In adults, deficiency gives rise to the condition known as osteomalacia which leads to the softening of the bones and increased chances of fractures

Iron

- A lack of iron causes anaemia
- An adult needs about 16mg of iron a day
- Women need enough iron in their diet to facilitate their menstruation cycle
- Tiredness, lack of energy, shortness of breath, heart palpitations and a pale complexion

Digestion

- Ingestion is the taking of substances through the mouth
- Digestion is the breaking down of large insoluble food molecules into small soluble molecules so that they can pass through the gut wall into the blood
- Absorption is the movement of small food molecules and ions through the wall of the intestine into the blood
- Assimilation is the movement of digestive food molecules into the cells of the body where they are used, becoming part of the cells
- Egestion is the passing out of food that has not been digested or absorbed as faeces through the anus

Mechanical Digestion

- Breakdown of large pieces of food into smaller pieces of food without changing the molecules
- Creates a larger surface area for enzymes to work on
- Continues in the stomach-muscular contractions (peristalsis)
- Small intestine: large globules of fat are broken down into smaller ones (emulsification by bile)

Chemical Digestion

- Breakdown of large insoluble food molecules into smaller soluble molecules by the action of enzymes
- Makes these molecules soluble i.e. it can be absorbed through wall of small intestine into bloodstream/lymph (fat)
- Occurs in mouth, stomach and small intestine

Protease: protein molecule → amino acids

Carbohydrase: starch molecule → glucose

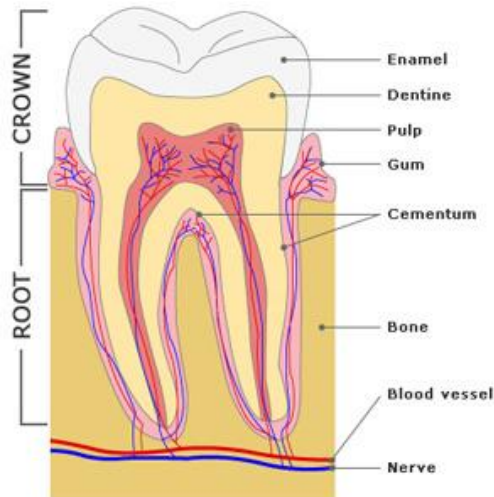
Lipase: fat molecule → fatty acids (3) and glycerol (1)

Teeth

- The teeth carry out mechanical digestion and break down food into smaller pieces
- The teeth increase the surface area of food to aid the enzymes catalyse reactions
- Adult humans have 32 teeth

<u>Tooth</u>	<u>Shape</u>	<u>Function</u>
Incisors (8)	Chisel- shaped	Biting and cutting
Canines (4)	Pointed	Piercing and tearing
Premolars(8)	Uneven cusps	Grinding and chewing
Molars (12)	Similar to premolars	Chewing

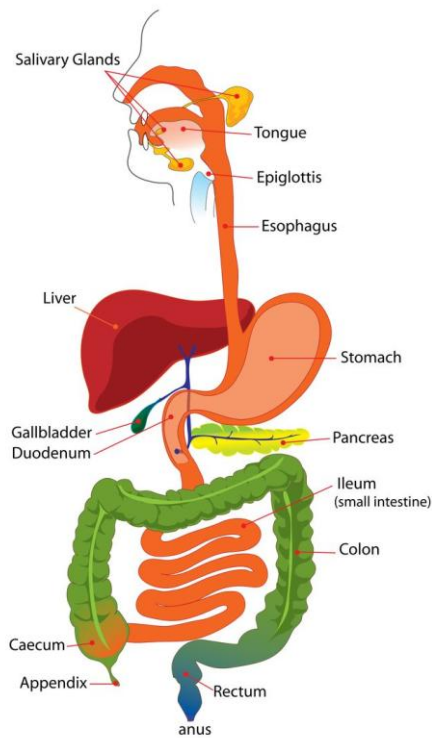
- During our lives we have two sets of teeth
- The first set, milk teeth only have 8 molars
- Between the ages of 6-12 these teeth gradually fall out and are replaced by permanent teeth
- The last of the permanent teeth come through at 18, called back molars or wisdom teeth



- Enamel forms the hard, outer layer of the crown of the tooth, above the gum
- Inside this is softer dentine which is like a bone in structure
- A layer of cement fixes the root of the tooth into a bony socket in the jaw
- The root is the part that is below the gum
- The pulp cavity is a space in the tooth containing several nerves and blood vessels

Healthy teeth and gums

- Tooth decay is caused by bacteria in the mouth, they mix with saliva to make plaque
- Bacteria in plaque changes sugar into acid via anaerobic respiration
- The acid can attack the enamel and propel tooth decay
- The acid will then attack dentine and subsequently the pulp cavity and will cause severe tooth ache
- The acid will make gums red and swollen
- Brushing teeth at a 45° angle clean the outside teeth with short gentle movements
- Brush the inside of the teeth by moving the brush gently back and forth
- Brush biting surfaces with short scrubbing strokes
- Tooth decay can be avoided with a good toothbrush, not eating sugary foods and regular dental visits



Mouth, oesophagus and stomach

Chewing and swallowing

- The incisors and canining teeth bite the food into chunks
- The molar and premolar teeth grind the food into smaller pieces
- The tongue mixes the food with saliva and the moistened food is chewed
- The food is then rolled into a ball or bolus
- The salivary glands make saliva which contains:
 - i. Mucus; a slimy substance that lubricate the passage of the food bolus down the throat
 - ii. Amylase; the enzyme that catalyses the breakdown of starch to maltose
- The food pushes your soft palate upwards preventing food from going into your nose
- When you swallow, the epiglottis covers the opening to your trachea
- The food squeezes past your epiglottis and into your

oesophagus

The oesophagus/gullet

- Food passes down the oesophagus into the stomach
- Has longitudinal muscles in its wall
- The movement of food down the oesophagus is due to the contraction of muscles called peristalsis
- The circular muscles relax and the longitudinal muscles contract to widen the oesophagus to move the food along
- Peristalsis also occurs in the large intestine

The Stomach

- Muscular bag that can hold 1 or more litres of food
- The walls of the stomach make gastric juice
- This contains pepsin that digests proteins to smaller molecules called polypeptides
- Gastric juice also contains hydrochloric acid which carries out two important function due to its low pH:
 1. It kills bacteria in food and the low pH denatures the enzymes in harmful microorganisms
 2. The acid provides the optimum conditions for the enzyme pepsin
- The mixture, of food, gastric juice and hydrochloric acid is known as chyme
- The muscular walls of the stomach churn up the food making sure it mixes well with the juices
- After 2-3 hours of churning, the contents of the stomach are like a runny liquid
- A ring of muscle called the pyloric sphincter opens to let the food pass a little at a time into the first part of the small intestine, the duodenum

The small intestine and absorption

- The small intestine is 6m long
- The first part is the duodenum that leads to the ileum
- The pancreas is connected to the duodenum by the pancreatic duct
- Pancreatic juice flows down the duct to meet food arriving from the stomach. Pancreatic juice contains:
 - i. Amylase → breaks down starch to maltose
 - ii. Trypsin → a protease that breaks down proteins and polypeptides to peptides
 - iii. Lipase → breaks down fats to fatty acids and glycerol
- The enzymes do not all work well under acid conditions so the pancreas created an alkali (sodium hydrogen carbonate) that neutralises the acidic food which enter the duodenum from the stomach
- Bile enters the duodenum through the bile duct
- Bile is a yellow-green fluid made in the liver and stored in the gall bladder
- Bile is alkaline and neutralises the acid which is added to food in the stomach
- Bile emulsifies fat by breaking down large globules of fat into smaller globules
- Cells lining the ileum make enzymes that complete the digestion of food:
 - i. Proteases that break down peptides to amino acids
 - ii. Sucrase that breaks down sucrose to glucose and fructose
 - iii. Maltose is broken down by maltase to glucose on the membrane of the epithelium lining the small intestine

Absorption

- Absorption is the movement of digested food molecules through the wall of the intestine into the blood or lymph
- Digested food includes simple sugars, amino acids, fatty acids and glucose
- These molecules pass through the walls of the intestine either by diffusion or by active transport
- The small intestine has adapted to its function of absorption by:
 - i. Having a large surface area (9cm^2)
 - ii. A thin lining (one cell thick) so digested food can easily pass into the blood and lymph
- The small intestine has a folded inner lining with millions of tiny, finger-like projections called villi. The epithelial cells lining the villi have microscopic projections called microvilli, these vastly increase the absorptive area of the cell membrane of the epithelial cells
- The digested food reaches the capillaries and lactals (lymph capillaries) in the villi
- Absorbed food molecules are transported quickly to the liver by the hepatic portal vein
- Fatty acids and glycerol are transported by the lymph
- Movement of the gut empties the lactal and lymph moves slowly through the lymphatic vessels which are thin walled veins, eventually enter the blood near the heart. As a result, fat does not enter the bloodstream quickly.

Large intestine and intestinal disease

The large intestine

- The large intestine is about 1.5m long and can be divided into the caecum, appendix and rectum
- By the time the food gets to the colon, it is now mainly fibre, dead cells and some water as most has been absorbed by the small intestine
- The solid waste, or faeces is stored in the rectum and egested through the anus

Cholera

- Cholera is a disease caused by bacteria
- The main symptom is diarrhoea (loss of watery faeces from the intestine)
- Some are infected by the disease but may not actually suffer from the disease, this is called symptomless carriers

Transmission

- Cholera occurs in areas where there is lack of proper sanitation, an unclean water supply or contaminated food
- Cholera is transmitted through the ingestion of contaminated water or contaminated food which has faecal material
- Transmission can occur by infected people handling food or utensils without washing their hands

Effects on the body

- Most of the bacteria of cholera is killed by acidic conditions in the stomach, however, some pathogens may survive and reach the small intestine. Here they burrow through the mucous lining the wall of the intestine and start to produce a toxin
- Molecules of this toxin enter the epithelial cells of the intestines here they disrupt the functioning of the cell surface membrane of the epithelial cells
- Chloride ions pass out the cells into the space inside the intestine
- The accumulation of ions in the lumen creates a water potential gradient
- Water flows by osmosis from the cells and from the blood into the lumen
- Movement of the ions and water from the blood into the lumen of the intestine cause symptoms of cholera-dehydration and diarrhoea

Oral Rehydration Therapy

- Cholera is treated by giving people a solution of salts and glucose to drink. This is oral rehydration therapy (ORT)
- The ORT solution contains water to rehydrate blood and other tissues, sodium ions to replace the ions lost from blood and tissue fluid, glucose to provide energy for the active uptake of sodium ions from the intestine, other ions such as potassium and chloride ions to replace those lost in diarrhoea
- During a cholera outbreak, sachets containing salts and glucose are made available, the contents of these packages dissolve in the boiling water so the administrator requires little training to administer-2
- the medicine in large volumes at regular intervals
- When these ions are absorbed the water potential of the epithelial cells decreases and water is absorbed to make up for the water lost in diarrhoea