Chapter 5: Nutrition in Humans

Alimentary Canal

Associated organs to the Digestive system: Liver, gallbladder, pancreas

What is Nutrition?

Nutrition is the process by which organisms obtain food and energy for growth, repair and maintenance of the body

It consists of the following processes:

Process	What is it?
Feeding or Ingestion	Taking in food into the body
Digestion	Large food molecules are broken down into smaller soluble molecules for absorption into body cells
Absorption	Nutrients move from the small intestine into the bloodstream
Assimilation	Nutrients are used by cells to provide energy or to make new cytoplasm for growth
Egestion	Removal of undigested food waste from the body

The function of the human digestive system is to break down large complex food substances into smaller and simple food substances

Physical Digestion	Mechanical Breakdown of large pieces of food into smaller pieces of food The Identites of the food substances remain unchanged, as no new products are formed	To increase the surface area-to-volume ratio	Mouth → chewing action Stomach → churning action Small Intestine → emulsification
Chemical Digestion	It is the process by which large insoluble complex food substances are broken down into smaller soluble simple substances. The identities of the food substances changed, as new products are formed	To allow food substances to be absorbed into the bloodstream through the intestinal wall	Mouth → starch Stomach → proteins Small intestine → carbs, proteins, lipids

The Mouth and Buccal Cavity

Food enters the body through the mouth which leads to the Buccal Cavity

Salivary glands produce saliva which consists of a mixture of salivary amylase and mucus.

The salivary amylase breaks down starch into maltose

Teeth breaks large pieces of food into smaller pieces. Chewing helps to increase the surface area of the food so that enzymes can act on it more effectively

The tongue helps to mix the food with the saliva and pushes the food to the back of the mouth while swallowing. The tongue rolls food into small, slippery and round masses called boli.

The Pharynx

The pharynx connects the buccal cavity to the oesophagus, the larynx and the trachea.

The glottis is a slit located at the larynx

Both food and air passes through the pharynx when food enters the body.

Air passes through the trachea while food passes through the oesophagus.

The epiglottis closes over the glottis to prevent the food from reaching the larynx and trachea while swallowing

Oesophagus (gullet → no digestion)

It is a long narrow muscular tube that passes through the thorax (chest) and diaphragm. it connects the mouth and the stomach.

The muscles of oesophagus consists of a layer of circular muscles (inner wall) and a layer of longitudinal muscles (outer wall) which are antagonistic muscles (one muscle relax and another muscle contract to create movement)

Circular muscles and longitudinal muscles are present along the whole gut from the oesophagus to the rectum.

Food travels to the stomach with the help of peristalsis.

Peristalsis

It refers to the rhythmic, wave-like muscular contradiction in the wall of the alimentary canal

It enables food to be mixed with digestive juices and helps to push and propel food along the gut.

To push the bolus forward

The circular muscles contracts and the longitudinal muscles relax. The wall of the gut constricts and becomes longer and narrower to squeeze the food forward.

Near the other end of the bolus

The circular muscles relax and the longitudinal muscles contract. This causes the wall of the gut to dilate and become shorter and wider. this allows the lumen to become wider and allow the bolus to move into a new position.

Stomach → muscular → act as a food storage which can hold food for a few hours

→ lies beneath the diaphragm, to the left side of the abdomen and partially covered by the liver.

→ Has numerous pits and gastric glands found in the stomach lining.

has secrete gastric juices that plays an important part in digestion

Gastric Glands consists of:

Hydrochloric Acid

Pepsin

Mucus

Hydrochloric Acid provides an acidic environment (pH 2) which is the optimum pH for pepsin to function efficiently

It also helps to kill bacteria

Stops the action of amylase by denaturing it

Pepsin digest proteins into polypeptides (incomplete)

Mucus forms a protective barrier that prevents pepsin from digesting the stomach wall.

Moistens food so that food can move within the stomach easily.

Small Intestine

Contains the U-shaped duodenum and the much-coiled ileum.

It carries out most of the digestion process

Enzymes in the small intestine speed up the rate of digestion

Contains glands in the wall lining, that secretes digestive enzymes

Absorption of nutrients and water from food usually takes place in the ileum.

Large intestine

Shorter and broader than the small intestine

consists of a colon, rectum and anus

absorbs the remaining water and mineral salts from the undigested food

temporarily stores faeces in the rectum

Liver

the largest gland in the body, located below the diaphragm

Three blood vessels are attached to the lower surface of the liver: the hepatic portal vein, the hepatic vein and the hepatic artery.

Liver cells produce and secrete bile that contains bile salts that aids in the emulsification of fats

→ Bile does not contain enzymes

Gall Bladder

The gall bladder is attached to the liver

It stores bile produced by the liver temporarily.

When the gall bladder contract, it releases bile into the duodenum via the bile duct.

Pancreas

It is connected to the duodenum via the pancreatic duct. The bile duct joins the pancreatic duct before the pancreatic duct opens into the duodenum

It produces pancreatic juices which contains pancreatic amylase, lipase and protease.

It also secretes hormones insulin and glucagon which are essential in regulating blood sugar concentration in our body.

Process that takes place in the mouth

Salivary glands produces and secretes saliva which contains a mixture of salivary amylase and mucus

The tongue helps to mix the food with saliva and saliva helps to soften the food

Salivary amylase digests starch into maltose

The optimum pH for salivary amylase to act on it pH 7

Food is broken down into smaller pieces by chewing, which increases surface area-to-volume ratio for salivary amylase to act on it more efficiently

The tongue helps to move the food to the back of the mouth during swallowing.

The tongue rolls the food into small and slippery round masses called boli. The boli is swallowed and it travels from the mouth to the oesophagus via the pharynx

Processes that takes place in the Stomach

Gastric glands found in the stomach lining secrete gastric juices

Peristalsis churns and breaks down the food and mixes the food with gastric juices

Gastric juices contains hydrochloric acid, protease (pepsin) and mucus.

Hydrochloric Acid which helps to create an acidic environment for protease to act on, kills bacteria and stops the action of salivary amylase by denaturing it

Mucus that helps form a protective barrier that protect the stomach wall by preventing protease on acting on it

Pepsin digest proteins into polypeptides

The food remains in the stomach for 3-4 hours, becoming a partially digested substance called chyme

chyme passes into the duodenum in small amounts

Processes that takes place in the small intestine

As chyme enters the duodenum, it stimulates the pancreas to release pancreatic juices

The pancreatic juices passes to the duodenum via the pancreatic duct

Pancreatic juices contains enzymes like amylase, lipase and protease

Gall baldder releases bile via the bile duct. The bile does not cotnain enzymes, it cannot digest food.

Bile speeds up the rate of fat digestion by breaking down large fat molecules into smaller fat molecules. {Emulsification]

The small intestine produces maltase, lipase and protease

(intestinal juices secreted by glands in the intestinal walls contain…)

The acidic chyme is neutralised by alkaline fluids released by pancreas, small intestine and gall bladder, thus acheiving a pH of 8, which is suitable for digestion to take place.

Carbohydrates after absorption

Most of the absorbed sugars are converted into glycogen and stored in the liver or muscles. Some of the glucose leaves the liver through the hepatic vein and is transported to the rest of the body, where cells absorb it and use it for energy

Amino Acids after absorption

Amino acids are transported into cells and are converted into new cytoplasm that is used for growth and repair of worn-out parts in the body

Amino acids are also used to make enzymes and hormones

Excess amino acids are transported into the liver, where their amino groups are removed and they are converted into urea. (Hepatic Vein has high in urea)(This process is called deamination)

Urea is removed from the body in the urine. The deaminated amino acids are converted into glycogen and stored in the liver.

Fats after absorption

Fats enter the lacteal and are carried away by the lymphatic system. he lymphatic vessels then join together to form larger vessels that eventually enter the bloodstream.

When there is enough glucose, fats are not broken down and they are stored in tissues and used to build protoplasm like cell membranes.

When glucose is short in supply, fats are broken down and are used as energy so that vital activities in the body can take place

Excess fats are stored in adipose tissues under the skin or around the heart and kidney. Adipose tissues act as a shock absorbers to protect the organs.

Structure and Function of the VIlli

Where digested substances are absorbed

Glucose and Amino Acids move by diffusion + active transport into the blood capillaries of the villi and to be transported to the liver

glycerol and fatty acids move by diffusion + active transported into the epithelium, where they recombine to form minute fat globules, that enters the lacteal and is carried away by the lymphatic system

How is Small Intestine adapted for absorption?

Functions of the Liver

→ Production of Bile

→ Deamination of amino acids

→ Regulation of blood glucose concentration

→ breakdown of hormones

→ Detoxification

Harmful substances may be absorbed into the blood from the gut. Harmful substances are made harmless by the liver cells.

Alochol is also broken down in the liver, as alcohol can cause damage to the digestive systems and slow down brain functions

Liver Cells contain an enzyme which breaks down alcohol to compounds that can be used in respiration, providing energy for all cell activities

What is a hormone?

A chemical substances that is produced in very small quantities by an endocrine gland. it is transported in the bloodstream to target organs to exert its effect.

→ Can influence the **growth**, **activity** and **development** of an organism.

→ Hormones are chemical messengers that help various parts of the body respond, develop and work together smoothly.

Some glands produce only hormones, while other glands produce both hormones and other secretion.

→ pancreas produce pancreatic juice and hormones insulin and glucagon

Effects of Alcohol Consumption

Effects on the Digestive System

→ Alcohol stimulates stomach acid secretion

→ Excess stomach acid can lead to the risk of gastric ulcers

→ Too much alcohol can also lead to cirrhosis (hardening of the cell) of the liver.

Cirrhosis is a disease in which the liver cells are destroyed and replaced with fibrous tissues, making the liver unable to function

Cirrhosis may lead to haemorrhage infection, and subsequently, death

Impacts on the Nervous System

→ Depressant

Alcohol slows down some brain functions.

→ Reduced self control

A person may become carefree as alcohol takes away their self control.

→ Effects on Reaction Time

Slurred speech, blurred vision and poor muscular coordination. Unable to move steadily

Judgment deteriorates, and they may underestimate speed/ They may tend to drive faster with less caution, and their reactions are slower, which may cause traffic accidents

Long-term Impacts on the Brain

Wet Brain:

A type of dementia caused by brain damage

Alcohol interferes with the absorption of vitamin B1 in the small intestine

Vitamin B1 is part of an enzyme that is involved in the breaking down of sugar to provide energy for brain activities in the conduction of nerve impulses