The digestive system

Level 2 Anatomy and physiology
for exercise and fitness instructors

Learning outcomes

By the end of this session you will be able to:

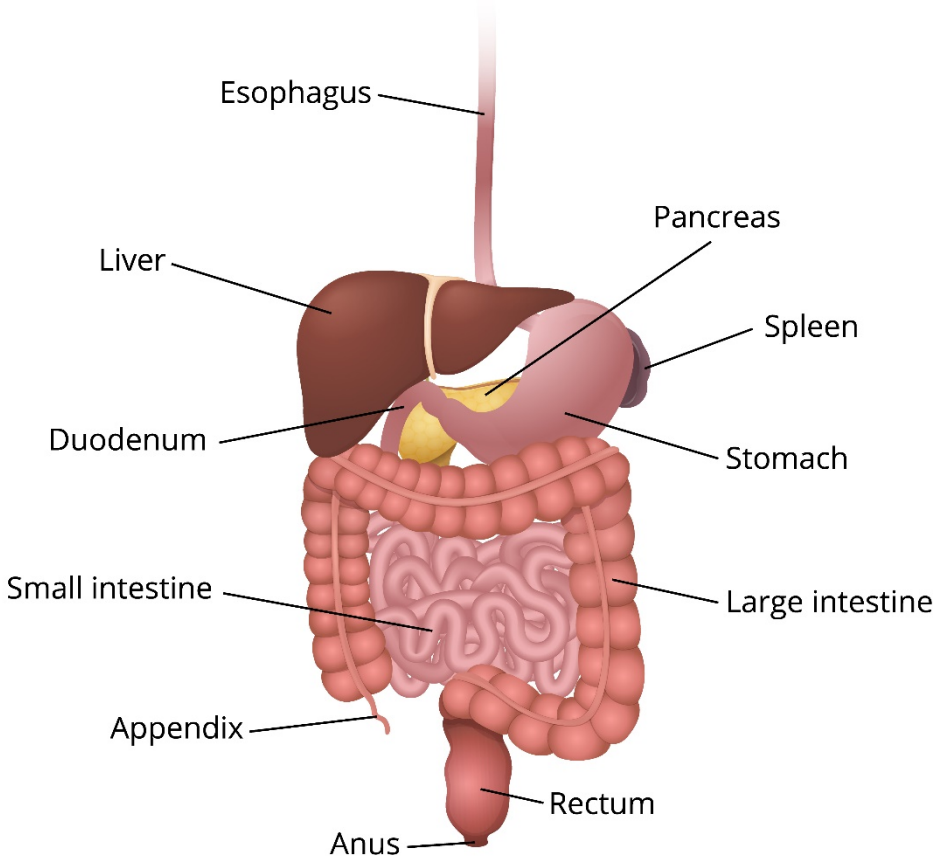
- Identify the function of the following in the digestive process: mouth (tongue, teeth, salivary glands), pharynx, oesophagus, stomach, pancreas, gallbladder and bile ducts, liver, small intestine, large intestine (colon)
- Describe how the main nutrient groups are broken down and absorbed in the digestive system
- Identify the role of fibre in the digestive process

Learning outcomes

By the end of this session you will be able to:

- Identify the role of the liver and pancreas in assisting digestion
- Identify the timescales for the digestive process to take place
- Describe the importance of fluid intake in the digestive process

Human digestive system



The digestive system

Digestion occurs through physical (mechanical) and chemical actions that take place in the digestive system

The process breaks down the food eaten and extracts the nutrients the body requires

Protein, fat and carbohydrates are broken down to their simplest form

Water is absorbed to aid hydration

The mouth

- Food is chopped and torn by the teeth – '**mastication'**
- It is moistened with saliva and swallowed
- Saliva contains the digestive enzyme, **salivary amylase**, which starts a chemical breakdown of starchy carbohydrate into simpler sugars
- There is no chemical breakdown of fat or protein in the mouth

The pharynx

- The pharynx is part of both the digestive and respiratory systems.
- Movement of food from the mouth to the oesophagus
- Because the pharynx serves two different functions, it contains a flap of tissue known as the epiglottis that acts as a switch to route food to the oesophagus and inspired air to the larynx

The oesophagus

- From the mouth, the food is pushed into the oesophagus to travel to the stomach by a process called **‘peristalsis’**
- Peristalsis is rhythmical waves of muscle contractions which help push food towards the stomach
- No physical or chemical breakdown takes place at this stage

The stomach

- Smooth muscle fibres break up remaining food chunks into a thick liquid called chyme (pronounced kyme)
- **Pepsin** breaks protein into smaller amino acid chains
- Peptides and gastric lipase break down short-chain triglycerides into fatty acids and monoglycerides
- These enzymes need acidic conditions and **hydrochloric acid** is pumped in
- The digestion in the stomach can take up to 5 hours
- Chyme is spurted into the small intestine

The small intestine

- Divided into 3 parts, duodenum, jejunum and ilium
- Major site for digestion and absorption of nutrients
- About seven metres long
- Breaks down nutrients into their usable components
- Partially digested food enters and is mixed with pancreatic enzymes that break down carbohydrates, protein and fat
- The surface is covered with millions of tiny **villi** and **microvilli** which provide a large surface area and are covered with blood capillaries for the absorption of nutrients
- Water absorption also occurs

The large intestine

- The final stage of digestion takes place in the large intestine with the partial breakdown of cellulose (soluble fibre)
- The large intestine's role is to reabsorb the remaining water from undigested food
- The undigested food and fibre ends up as faeces where it is passed to the colon and is then expelled from the body via the anal canal (rectum)

The liver

- The liver is located to the right of the stomach, just inferior to the diaphragm and superior to the small intestine
- The liver weighs about 3 pounds and is the second largest organ in the body
- The liver has many different functions in the body, but the main function of the liver in digestion is the production of **bile acids** and its secretion into the small intestine

The gall bladder

- The gallbladder is a small, pear-shaped organ located just posterior to the liver.
- The gallbladder is used to store and recycle excess bile from the small intestine so that it can be reused for the digestion of subsequent meals

The pancreas

- The pancreas is a large gland located just inferior and posterior to the stomach
- It is about 6 inches long

- The pancreas secretes digestive enzymes:
  - **lipase** (to break down fats into fatty acids)
  - **amylase** (to break down carbohydrates into glucose/sugar)
  - **trypsin** (to break down protein into amino acids)

Fibre

Fibre is needed to ensure efficient gut function and for the effective digestion and absorption of other nutrients

Dietary fibre may also assist in weight management as it can delay gastric emptying and lower the glycaemic index of high/moderate glycaemic index foods. This may make an individual feel fuller for longer and present a slow steady release of glucose into the bloodstream

Insoluble fibre - non-starch polysaccharide (NSP)

- Does not dissolve in water
- Passes through the gut without being broken down
- Helps other foods move through the digestive system
- Acts to bulk up stools and make waste move through the digestive tract more quickly
- Can help to prevent constipation

- Cereal foods - high fibre breakfast cereals;
- Wholemeal breads and pasta, brown rice, other wholegrains;
- Vegetables, potatoes with skins
- Nuts, seeds

Soluble fibre

- Dissolves in the water of the digestive system
- Appears to help reduce the amount of cholesterol in the blood
- Helps to make stools softer and easier to pass

- Grains - oats, barley, rye
- Fruits – bananas, apples
- Beans and pulses - baked beans, chickpeas
- Root vegetables – carrots, potatoes

Fluid

Fluid intake has an important role in the digestion

- Chemical reactions in all cells need water to be able to take place
- Assisting the removal of waste from the body
- Enabling the transport and absorption of nutrients around the body
- Preventing constipation

Digestive substances and enzymes

- Salivary amylase - enzyme in saliva
- Hydrochloric acid - gastric juice released in the stomach
- Pepsin - enzyme released in the stomach for breaking down protein
- Lipase - enzyme released by the pancreas to break down fats
- Amylase - enzyme released by the pancreas to break down carbohydrates into glucose
- Trypsin - enzyme released by the pancreas to break down protein into amino acids
- Bile acids - produced by the liver and stored in the gallbladder until released into the small intestine

Time scales for digestion

- It takes about 6-8 hours for food to pass through the stomach and small intestine
- Food then enters the large intestine for further digestion, absorption of water and elimination of undigested food
- Food can take 24-72 hours to move through the digestive tract
- The exact time will depend on the amounts and types of foods eaten, metabolism and any digestive issues
- Within 6-8 hours, the food has moved its way through the stomach, small intestine and large intestine

Time scales for digestion

- Once in the large intestine, the partially digested food can sit for more than a day while it's broken down even more
- Meat and fish can take as long as 2 days to fully digest due to the complex protein and fat molecules
- Fruit and vegetable which contain fibre move through the digestive system in less than a day
- Processed foods can be digested in a matter of hours