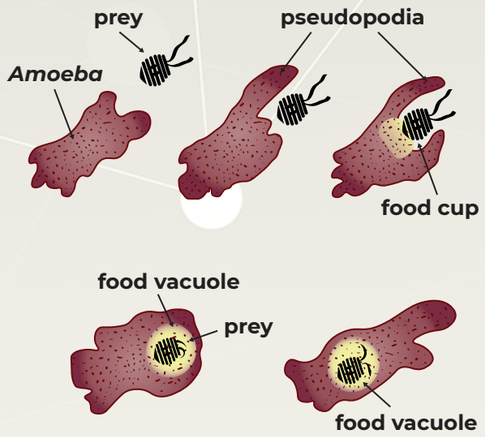
Adaptations for nutrition part 1

Unicellular organisms

1. Amoeba pseudopodia move around prey and enclose it in a food vacuole.
2. Enzymes are released and prey digested.
3. Products of digestion are absorbed into the cytoplasm and the undissolved waste left behind as the amoeba moves on.



Multicellular organisms

Organism	Gut
Hydra - single food source	Undifferentiated, sac-like gut with a single opening.
Earthworm - varied foods	A tube gut with different openings for ingestion and egestion and specialised regions for the digestion of different food.
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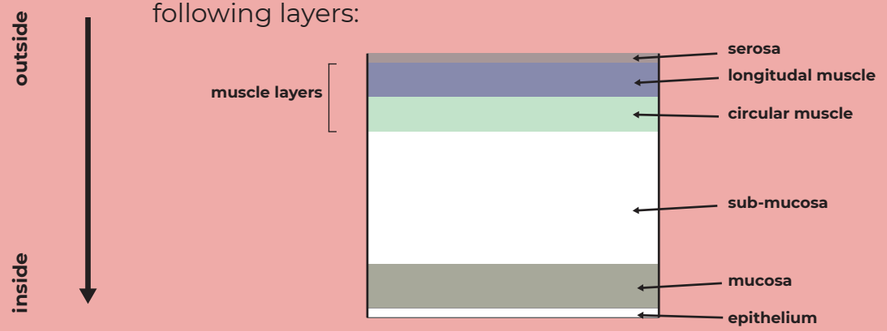
Human - omnivorous diet	Specialised regions of gut. The wall of the gut contains the following layers: 

Layer	Features
Serosa	Tough outer coat of connective tissue.
Muscle	Longitudinal muscle contracts to shorten the gut and circular muscle contracts to reduce diameter. These waves of contraction called peristalsis force food along the gut.
Submucosa	Contains blood and lymph vessels to remove digested food products.
Mucosa	Inner layer, secretes mucus for lubrication. In some areas secretes digestive juices in others absorbs products.
Epithelium	Layer of cells in contact with food.

Types of nutrition

Autotrophic – makes complex organic molecules from simple inorganic ones.	Photoautotrophic - Use light as a source of energy for synthesis of food.
	Chemoautotrophic - Oxidise inorganic molecules to provide energy for the synthesis of food.
Heterotrophic – consume complex organic food molecules.	Saprophytic- External digestion of food using secretion of enzymes followed by absorption of the products of digestion into the organism, e.g Fungi.
	Holozoic - Internal digestion of food, involves ingestion, absorption, assimilation and egestion.

Types of protease

Proteases called endopeptidases hydrolyse peptide bods between specific amino acids in the middle of the polypeptide chain to form peptides.

Exopeptidases hydrolyse peptide bonds on the end of peptides, from the free amino end or the free carboxyl end.

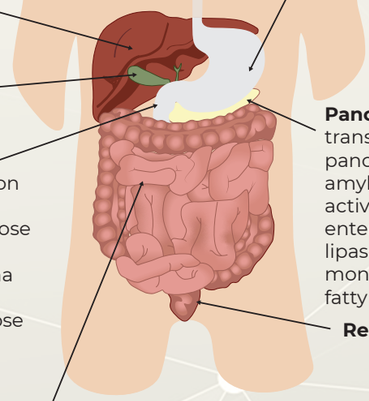
Buccal cavity - Mechanical digestion of food occurs here. The tongue moves food to the cutting and grinding surfaces of the teeth. Chemical digestion of starch and glycogen into maltose by the enzyme amylase. Saliva moistens food and also maintains the pH for the enzyme. The tongue then rolls the food into a bolus which is swallowed.

Liver - Produces bile. Bile emulsifies lipids to increase the surface area available for lipase enzymes to digest them. It also neutralises stomach acid to create a slightly alkaline pH in the duodenum for the pancreatic enzymes.

Gall bladder - Stores the bile before delivering it to the duodenum via the bile duct.

Duodenum - Further digestion occurs on the epithelial cells of the villi.
- Sucrose digested by sucrase into glucose and fructose.
- Maltose digested by maltase into alpha glucose.
- Lactose digested by lactase into glucose and galactose.
- Further digestion of polypeptides by endopeptidases and exopeptidases.

Ileum
- Amino acids are actively transported into the epithelial cells of the villi, facilitated diffusion then occurs into the capillaries in the villi.
- Glucose and other monosaccharides move into epithelial cells by co-transport with sodium ions, facilitated diffusion then occurs into the capillaries in the villi.
- Fatty acids and glycerol diffuse into epithelial cells and are reassembled into triglycerides and carried by the lacteal to the lymphatic system.

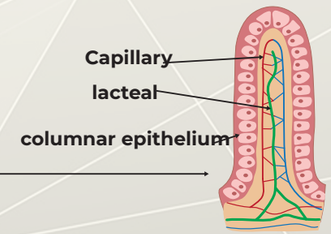


Oesophagus – peristaltic waves of muscle contraction push the bolus of food down to the stomach. Mucus lubricates the way.

Stomach - Gastric glands in the mucosa produce gastric juice. The Oxyntic cells produce hydrochloric acid (HCl) that kills bacteria and lowers the pH to 2. The chief or peptic cells produce pepsinogen, the inactive precursor of the endopeptidase enzyme, pepsin. This is activated by the HCl. Finally, the goblet cells produce mucus to protect the stomach lining.

Pancreas - produces enzymes that are transported to the duodenum via the pancreatic duct. Carbohydrase - pancreatic amylase. Protease – trypsinogen that is activated into the endopeptidase Trypsin by enterokinase in the duodenum. Pancreatic lipase enzymes digest triglycerides into monoglycerides and eventually glycerol and fatty acids.

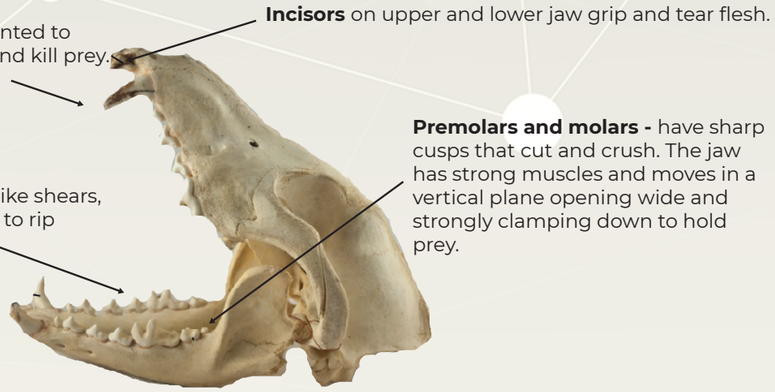
Rectum and anus



A villus - The villi increase the surface area in the small intestine for absorption of digested food into the blood.

Adaptations for nutrition part 2

Carnivore- adaptations to a high protein/lipid/energy diet



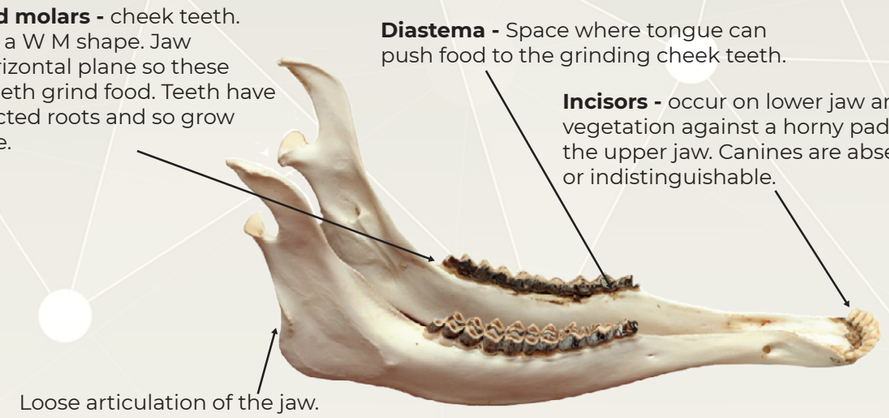
Gut

- Relatively short gut.
- Usually a large stomach for digestion of mostly protein diet.
- Small, useless caecum.

Parasites – obtain nutrition at the expense of a host organism.

An **ectoparasite** lives **on the surface** of another organism.	An **endoparasite** lives **inside** another organism.
The head louse (*Pediculus*) feeds by sucking blood from the scalp of the host. • It has claws to hold onto the hairs. • Lays eggs which are glued to the base of hairs. • Transfer between hosts is by direct contact as it cannot jump, only crawl. 	The pork tapeworm, *Taenia solium*. The adult tapeworm lives in the gut of humans. 1. Primary host - a larval form develops in pigs. 2. Secondary host - infection of humans occurs when a person eats pork containing live larval forms. The gut is a hostile environment due to the presence of various secretions and peristalsis. The tapeworm has adapted to living in the gut by: • Thick cuticle produces anti-enzymes. • Scolex to attach to the gut wall. • *Taenia solium* has a reduced gut and feeds by absorbing pre-digested nutrients through its cuticle. • To increase the chances of infecting a secondary host it produces large numbers of eggs that pass out in the faeces. 

Herbivore- adaptations to a high cellulose diet



Gut

Non-ruminants

- Very long gut for the difficult process of cellulose digestion.
- Large caecum containing bacteria that produce cellulase for cellulose digestion.

Ruminants