WJEC (Wales) Biology A-level

Unit 2.4 - Adaptations for nutrition

Flashcards

Define autotrophic.

Define autotrophic.

- An organism that produces its own food
- It manufactures complex organic compounds from simpler inorganic molecules such as water and carbon dioxide

Name the two types of autotrophic organisms.

Name the two types of autotrophic organisms.

- Photoautotrophic
- Heterotrophic

What is a photoautotrophic organism?

What is a photoautotrophic organism?

An organism which obtains its nutrition through photosynthesis.

What is a chemoautotrophic organism?

What is a chemoautotrophic organism?

An organism which obtains its nutrition through inorganic molecules, such as sulfur, in the absence of light.

Define heterotrophic.

Define heterotrophic.

An organism that cannot produce its own food. It obtains energy by feeding on organic compounds produced by other organisms.

What is a saprotroph?

What is a saprotroph?

An organism that feeds by extracellular digestion, e.g. fungi.

Describe extracellular digestion by saprotrophs.

Describe extracellular digestion by saprotrophs.

- Release enzymes which catalyse the breakdown of dead plant and animal material into simpler organic matter
- Absorb the products of digestion

What is meant by the term ‘holozoic’?

What is meant by the term ‘holozoic’?

Describes a heterotrophic organism that internally digests food substances.

What processes does holozoic nutrition involve?

What processes does holozoic nutrition involve?

Ingestion, digestion, absorption, assimilation and egestion.

Define ingestion.

Define ingestion.

The process by which organisms take food into their bodies.

Define digestion.

Define digestion.

The processes by which large, insoluble molecules are broken down into smaller, soluble molecules that can be absorbed across cell membranes.

Name the two types of digestion.

Name the two types of digestion.

- Mechanical digestion
- Chemical digestion

What is mechanical digestion?

What is mechanical digestion?

- Type of digestion that involves physically breaking down food material into smaller pieces
- Increases the total surface area for chemical digestion

What is chemical digestion?

What is chemical digestion?

A type of digestion that involves breaking down large, insoluble molecules into smaller, soluble molecules using enzymes.

What is assimilation?

What is assimilation?

The synthesis of biological compounds from absorbed simpler molecules.

Define absorption.

Define absorption.

The movement of useful substances into the bloodstream.

Define egestion.

Define egestion.

The removal of undigested waste material from the body.

Describe how unicellular organisms obtain nutrients.

Describe how unicellular organisms obtain nutrients.

- Ingestion via **phagocytosis**
- **Intracellular digestion** (using hydrolytic enzymes) breaks down large, insoluble molecules into smaller, soluble molecules
- Products of digestion pass into the cytoplasm by **diffusion** and **active transport**
- Undigested material removed by **exocytosis**

What is a *Hydra*?

What is a *Hydra*?

A small, multicellular, freshwater organism of the phylum Cnidaria.

Describe the structure of *Hydra*.

Describe the structure of *Hydra*.

- Basic, undifferentiated sac-like gut
- Single opening, surrounded by tentacles, that serves as a mouth and an anus
- Single gut cavity (known as the enteron)

Outline the process of digestion in *Hydra*.

Outline the process of digestion in *Hydra*.

- **Hydrolytic enzymes** secreted into the enteron by the endodermis
- **Extracellular digestion** partially digests food molecules
- **Partially digested** food transported, via **phagocytosis**, into endodermal cells where **intracellular digestion** takes place
- Undigested material **egested** from the enteron via the single opening

Describe the shape of the gut in more complex organisms.

Describe the shape of the gut in more complex organisms.

Tube-like with two openings, a mouth for ingestion and anus for egestion.

What type of diet is the human gut adapted to?

What type of diet is the human gut adapted to?

An omnivorous diet consisting of plant and animal material.

State the names of the different layers of the gut wall.

State the names of the different layers of the gut wall.

- Epithelium
- Mucosa
- Submucosa
- Muscle layer
- Serosa

What is the epithelium?

What is the epithelium?

A single layer of cells that line the gut wall.

Describe the structure of the mucosa layer of the gut wall.

Describe the structure of the mucosa layer of the gut wall.

- Mucous membrane lining the gut wall
- Contains glands that secrete digestive enzymes, mucus, and an acid or alkaline liquid that provides an optimum pH

Describe the structure of the sub-mucosa layer of the gut wall.

Describe the structure of the sub-mucosa layer of the gut wall.

- Layer of connective tissue below the mucous membrane
- Contains blood vessels and lymph for the transport of digestion product and glands that secrete an alkaline fluid

Describe the muscle layer of the human gut.

Describe the muscle layer of the human gut.

A layer of circular and longitudinal muscles beneath the submucosa.

Explain the action of circular and longitudinal muscles in peristalsis.

Explain the action of circular and longitudinal muscles in peristalsis.

The contraction of the circular muscle behind the bolus of food and the relaxation of the longitudinal muscle in front forces food down the gut.

What is the serosa?

What is the serosa?

The tough, protective layer that surrounds the gut.

What is the buccal cavity?

What is the buccal cavity?

The oral cavity through which food enters the body.

Which type(s) of digestion take place in the buccal cavity?

Which type(s) of digestion take place in the buccal cavity?

Mechanical digestion and **chemical** digestion of starch.

What is the normal pH range of the buccal cavity?

What is the normal pH range of the buccal cavity?

pH 6.5 to 7.5

What is the function of the teeth?

What is the function of the teeth?

Crush and grind food into smaller pieces, increasing its surface area.

What is the tongue?

What is the tongue?

A muscular organ in the buccal cavity that is vital in the chewing and swallowing of food.

Describe the function of salivary glands.

Describe the function of salivary glands.

Secrete amylase, mineral ions and mucus into the buccal cavity.

What is the function of the oesophagus?

What is the function of the oesophagus?

Carries food from the buccal cavity to the stomach by peristalsis.

Describe the processes that take place in the stomach.

Describe the processes that take place in the stomach.

Mechanical digestion (mixing and grinding) and **chemical digestion** of protein.

What type of glands are found in the stomach?

What type of glands are found in the stomach?

Gastric glands

Describe the function of gastric glands.

Describe the function of gastric glands.

Secrete endopeptidases, hydrochloric acid and an alkaline mucus into the stomach.

What is the normal pH of the stomach?

What is the normal pH of the stomach?

pH 2

What is the role of the liver?

What is the role of the liver?

Secretes bile into the small intestine via the gallbladder and bile duct.

Describe the composition and function of bile.

Describe the composition and function of bile.

- Consists of bile salts and an alkaline fluid
- Neutralises stomach acid, providing an ideal pH for lipase

State the two main divisions of the small intestine.

State the two main divisions of the small intestine.

- Duodenum
- Ileum

What is the duodenum?

What is the duodenum?

The first section of the small intestine where proteins and lipids are hydrolysed.

What is the ileum?

What is the ileum?

The second section of the small intestine that serves as the main site of absorption of the products of digestion.

What is the normal pH range of the small intestine?

What is the normal pH range of the small intestine?

pH 7 to 8

What is the pancreas and where is it located?

What is the pancreas and where is it located?

A gland situated behind the stomach.

Describe the role of the pancreas.

Describe the role of the pancreas.

It secretes enzymes and an alkaline fluid into the duodenum via the pancreatic duct.

What is the large intestine also called?

What is the large intestine also called?

Colon

Describe the function of the colon.

Describe the function of the colon.

Reabsorbs water and minerals from the waste material.

What is the rectum?

What is the rectum?

The segment of the large intestine that stores faeces prior to egestion.

Which enzymes are involved in carbohydrate digestion? Where are they found?

Which enzymes are involved in carbohydrate digestion? Where are they found?

- **Amylase** in saliva and pancreatic juice
- **Maltase**, **sucrase**, **lactase** on the membrane of the epithelial cells of the small intestine

What are the substrates and products of the carbohydrases?

What are the substrates and products of the carbohydrases?

- **Amylase** hydrolyses **starch** to **maltose**
- **Maltase** hydrolyses **maltose** to **alpha-glucose**
- **Sucrase** hydrolyses **sucrose** to **glucose** and **fructose**
- **Lactase** hydrolyses **lactose** to **glucose** and **galactose**

What is the optimum pH of amylase?

What is the optimum pH of amylase?

pH 8

Which enzymes are involved in protein digestion? What are their roles?

Which enzymes are involved in protein digestion? What are their roles?

- **Endopeptidases** - hydrolyse non-terminal peptide bonds within a protein to form smaller peptides
- **Exopeptidases** - hydrolyse the terminal peptide bonds of a protein to form dipeptides and amino acids

Give some examples of endopeptidases.

Give some examples of endopeptidases.

- Trypsin
- Pepsin

Describe how trypsin is produced.

Describe how trypsin is produced.

- Secreted by the pancreas as **inactive trypsinogen**
- **Enterokinase** converts inactive trypsinogen into **active trypsin** in the duodenum

Name the inactive form of pepsin.

Name the inactive form of pepsin.

Pepsinogen

Where is pepsinogen secreted from?

Where is pepsinogen secreted from?

Gastric glands

Describe how inactive pepsinogen is converted into its active form, pepsin.

Describe how inactive pepsinogen is converted into its active form, pepsin.

Hydrochloric acid converts inactive pepsinogen into active pepsin.

Where are lipids digested?

Where are lipids digested?

Small intestine

What must happen before lipids can be digested?

What must happen before lipids can be digested?

They must be **emulsified** by **bile salts** produced by the liver. This breaks down large fat molecules into smaller, soluble molecules called micelles, increasing the surface area.

How are lipids digested?

How are lipids digested?

Lipases hydrolyse lipids into monoglycerides, fatty acids and glycerol.

Where are lipases found?

Where are lipases found?

In pancreatic juice.

State the processes by which absorption takes place in the ileum.

State the processes by which absorption takes place in the ileum.

- Simple diffusion
- Facilitated diffusion
- Active transport
- Osmosis

Which molecules are absorbed by simple diffusion in the ileum?

Which molecules are absorbed by simple diffusion in the ileum?

Monoglycerides, fatty acids and glycerol.

Why can monoglycerides, fatty acids and glycerol be absorbed via simple diffusion?

Why can monoglycerides, fatty acids and glycerol be absorbed via simple diffusion?

They are non-polar molecules so can easily diffuse across the membrane of the epithelial cells.

What happens to monoglycerides, fatty acids and glycerol once they are absorbed into cells?

What happens to monoglycerides, fatty acids and glycerol once they are absorbed into cells?

They are reformed into triglycerides, absorbed into the lacteals and transported via the lymphatic system into the blood.

How are amino acids absorbed from the lumen of the gut?

How are amino acids absorbed from the lumen of the gut?

Via active transport into epithelial cells and then into the bloodstream by facilitated diffusion.

Which molecules rely on co-transport from the lumen of the gut into the cytoplasm of the epithelial cells?

Which molecules rely on co-transport from the lumen of the gut into the cytoplasm of the epithelial cells?

Glucose and other monosaccharides.

Explain how sodium ions are involved in co-transport.

Explain how sodium ions are involved in co-transport.

Sodium ions (Na^+) are actively transported out of the cell into the lumen, creating a diffusion gradient. Nutrients are then taken up into the cells along with Na^+ ions.

How do monosaccharides pass from the epithelial cells into the bloodstream?

How do monosaccharides pass from the epithelial cells into the bloodstream?

Via facilitated diffusion.

What are herbivores?

What are herbivores?

Animals that only eat plants.

Describe the adaptations of herbivores to a high cellulose diet.

Describe the adaptations of herbivores to a high cellulose diet.

- Long gut
- Loose articulation of the lower jaw
- Horny pad on the upper jaw
- Specialised dentition for grinding tough plant material

Describe how the dentition of a herbivore is adapted to its diet.

Describe how the dentition of a herbivore is adapted to its diet.

- Small, flat **incisors** on **lower jaw** for cutting grass against upper horny pad
- **Diastema** between incisors and premolars - separates fresh grass from the cud and enables manipulation of food by the tongue
- **Premolars** and **molars** have a large surface area and sharply ridged biting surfaces for grinding plant material

What are ruminants?

What are ruminants?

Mammals that digest plant material slowly in a specialised **four-chambered** stomach and regurgitate it to chew it again, enabling the efficient breakdown of fibre.

Name the four chambers of the ruminant stomach.

Name the four chambers of the ruminant stomach.

- Rumen
- Reticulum
- Omasum
- Abomasum

Describe the rumen.

Describe the rumen.

The first stomach of a ruminant. It contains mutualistic bacteria that are able to hydrolyse cellulose into glucose.

What is a carnivore?

What is a carnivore?

An animal that preys on and eats other animals.

Describe the adaptations of carnivores to a high protein diet.

Describe the adaptations of carnivores to a high protein diet.

- Short gut
- Powerful jaw muscles
- Specialised dentition for cutting and tearing meat

Describe how the dentition of a carnivore is adapted to its diet.

Describe how the dentition of a carnivore is adapted to its diet.

- Sharp **incisors** to remove flesh from bone
- Large, pointed **canines** required to grip and kill prey
- Sharp **carnassials** (modified premolars and molars) to slice and shear meat
- **Molars** with sharp, flattened edges to crush bone

What is a parasite?

What is a parasite?

An organism that lives on or in a host and takes nourishment at the expense of the other organism

Name the two types of parasite.

Name the two types of parasite.

- Ectoparasites
- Endoparasites

What are ectoparasites? Give an example.

What are ectoparasites? Give an example.

Parasites that live on the host e.g. Head louse, *Pediculus humanus*.

What are endoparasites? Give an example.

What are endoparasites? Give an example.

Parasites that live in the host e.g. Pork tapeworm, *Taenia solium*.

How does the head louse feed and transfer from one host to another?

How does the head louse feed and transfer from one host to another?

- Feeds by sucking blood from the host's scalp
- Transfers between hosts by direct contact

Where does the pork tapeworm live?

Where does the pork tapeworm live?

- **Primary host** - adult tapeworm lives in the human gut
- **Secondary host** - larval form can develop in pigs

How can humans and pigs become infected by the pork tapeworm?

How can humans and pigs become infected by the pork tapeworm?

- Humans become infected by consuming undercooked pork (containing larval forms of the tapeworm)
- Pigs may become infected by ingesting contaminated faeces

How does the pork tapeworm feed?

How does the pork tapeworm feed?

Absorbs pre-digested nutrients in the gut through its cuticle.

How is the pork tapeworm adapted to living in the gut?

How is the pork tapeworm adapted to living in the gut?

- Thick cuticle
- Secretes anti-enzymes that prevent its digestion by host enzymes
- Scolex has suckers and hooks for attachment to gut wall
- Long, thin body proves large surface-area-to-volume ratio for absorption