Objective 4- Digestion

1. **Describe why cells require nutrients**
   Supply energy for metabolism (cell activities), matter for synthesis of new materials, cell reproduction, secretion and to regulate cell processes

   Without these nutrients, our cells and body would not function properly

2. **Describe the simple chemistry of carbohydrates, proteins and lipids.**

   Organic compounds- Large molecules that always contain carbon
   - Needed for metabolism
   - Proteins, Carbohydrates, Lipids

   Inorganic
   - Water, CO₂, mineral ions

   **Carbohydrates**
   - C, 2H, O
   - Cereals and grains
   - Energy source

   Polysaccharides
   - Many Sugar
   - Polymer
   - Eg. Glycogen and Starch

   Disaccharide
   - 2 sugars

   Monosaccharide
   - Glucose

   **Proteins**
   - C, H, O, N
   - There are 20 proteins, 9 essential
   - Sources: Meat, Eggs, Nuts

   Polypeptide amino acids x100 = protein

   Dipeptide
   - 2 amino acids

   Amino acid

   **Lipids**
   - C, H, O Less O than Carbohydrates
   - Fats- triglycerides
   - Phospholipids
   - Steroids
   - Sources: Animal fats, vegetable oils

   **Energy values**
   Carbohydrates and Proteins: 1 gram gives 17 kilojoules of energy
   Fats: 1 gram gives 36 kilojoules of energy
3. Describe the basic function of vitamins, minerals and water.

Minerals- Function as co-enzymes or form part of substances such as ATP, involved in metabolism

Vitamins- Act as co-enzymes in chemical reactions

Water- The fluid in which substances are dissolved, location of chemical reactions

4. Distinguish between the alimentary canal and the digestive system.

**Alimentary canal**
Definition: the passage that extends from mouth to anus,
Function: Participates in digestion, absorption of food and nutrients and elimination of residual waste
Parts: includes the mouth, pharynx, esophagus, stomach, small intestine, and large intestine.

**Digestive system**
Definition: includes the alimentary canal, as well as the accessory organs associated with digestion
Parts: salivary glands, gall bladder, liver, pancreas.

5. List the six basic activities carried out by the digestive system

Ingestion of food
Mechanical digestion of food (physical)
Chemical digestion of food (involves enzymes)
Movement of food along the alimentary canal
Absorption of digested food and water into lymph and blood
Elimination of material that is not absorbed

6/7. Identify on a diagram the components of the digestive system

<table>
<thead>
<tr>
<th>Name</th>
<th>Function</th>
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<tbody>
<tr>
<td>Mouth</td>
<td>Begins mechanical digestion through chewing. Begins chemical digestion breaking starch into disaccharides (maltase) through salivary amylase.</td>
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</table>
| Teeth       | Perform mechanical digestion  
4 Incisors- Used for biting and cutting  
2 Canines- Tearing  
4 Premolars- Crushing and grinding  
6 Molars- Crushing and cringing |
| Tongue      | Pushes food to the roof of mouth forming a bolus and pushes backwards into the pharynx |
| Pharynx     | Connects the mouth to the oesophagus |
| Oesophagus  | Carries food from the mouth to the stomach, passes through the diaphragm into the abdominal cavity |
8. Distinguish between mechanical and chemical digestion.

Mechanical digestion is the physical breaking down of large pieces of food into smaller pieces. Examples: teeth cutting food into smaller pieces, emulsification of fats by bile

Chemical digestion is the chemical breaking of large molecules of food into smaller molecules. Examples: enzymes in saliva breaking starch down into smaller carbohydrate molecules
9. Describe the role played by mechanical digestion and the structures involved (teeth, bile and muscles (peristalsis)).

Breaks down food into smaller pieces
Mouth: Teeth break down the food through chewing
Oesophagus: Concentration of muscles separates food into smaller pieces (Peristalsis).
Stomach: Muscles contract in waves along the stomach wall
  - Waves of muscular contraction in the stomach wall
  - Churns the food
    - Circular (around)
    - Longitudinal (Length ways)
    - Oblique (diagonal)
  - Mixes with enzymes

10. Describe the chemical digestion of food - where it takes place; the enzymes involved; where they are produced and the substrates and end products.

Mouth: Salivary gland ———> Salivary Amylase
Breaks down starch a polysaccharide into maltose a disaccharide

Stomach:
Gastric juice- Secreted by gastric gland (mucosa)
Pepsinogen ——-> Inactive enzyme + HCl ——> Gastric protease ——-> Digests proteins into polypeptides

Gastric glands ———> Gastric Protease
Breaks down proteins (100 amino acids) into polypeptides (at least 10 amino acids)

Small intestine:
Pancreatic amylase from pancreas
Starch ——> Disaccharide
O-O-O-O ——> O-O  O-O
Pancreatic protease
Protein and polypeptide → dipeptide

Pancreatic Lipase
Lipid → Glycerol and Fatty acids

Intestinal amylase
Disaccharide → Monosaccharide (glucose)

Intestinal Protease
Dipeptide → Amino acid
O-O ----> O   O

Intestinal lipase
Lipid → Glycerol and Fatty acids

**Chyme** - Partially digested food
- Too large to be absorbed in blood stream

11. Outline the features of the ileum that facilitate absorption of nutrients.
- Large surface area, 6m long
- Mucosa has folds
- Villi (finger like projections (1mm))
- Micro villi on villi

Simple sugars, amino acids, water and water soluble vitamins absorbed into blood capillaries
- Active transport, otherwise only get 50% absorbed

Fatty acids and glycerol dissolved in epithelium, form lipids then absorbed into lacteals and then into lymphatic system.

12. Describe the form the nutrients are in when they are absorbed, where the nutrients are absorbed and how they are absorbed (simple diffusion or active transport).

13. Describe the role of the circulatory and lymphatic systems in absorption and transport of products of digestion via the liver to the tissues.

Nutrients are absorbed in the small intestine, which is lined by villi and microvilli where absorption occurs.
- Amino acids are absorbed by active transport into the blood capillaries.
- Simple sugars (glucose) are absorbed through active transport, through the villi wall into the blood capillaries.
- Fatty acids and glycerol are absorbed by simple diffusion, they then recombine to form lipids, which
enter the lacteals and are transported to lymph ducts

- Water and water-soluble vitamins are absorbed into the blood capillaries by diffusion

**Distinguish between elimination and excretion.**

Excretion - Removal of the wastes of cell metabolism for the body
  
  Eg. CO₂, Urea

Elimination - The removal of undigested food in the form of faeces

**List some factors that can affect the rate of movement of materials in the alimentary canal.**

- Size and contents of a meal
  
  Eg. Large meal ——> Material pushed into small intestine quicker
  
  High protein/ High fat ——> Slow movement

- Alcohol and Caffeine stimulate movement of the stomach

**Constipation**

- Movement of large intestine reduced
- Faeces become dry and hard
- Hard to defecate and possibly painful
- Caused by lack of roughage of cellulose/insoluble fibre in plants, lack of exercise or emotional problem

**Diarrhoea**

- Defecation of watery faeces
- Irritation of small or large intestine, increases peristalsis and less water is absorbed
- Caused by bacterial or viral infection, food poising, cholora,
- Causes dehydration

**Bowel Cancer**

- Uncontrolled growth of cells on large intestine wall
- Linked to diet, high alcohol consumption, smoking, over weight, high red/processed meat diet, inactivity

**Soluble fibre**

- Pectins, Gums, Mucilage
- Linked to low cholesterol levels in blood, decreased risk of heart disease and cancer and beneficial on glucose levels
- Prevents absorption of fats
- Sources: Fruits, Vegetables, Oat brand, Barley, Soy products

**Coeliac**

- Unable to tolerate gluten
- Immune system damages and destroys villi in small intestine
- Nutrients not absorbed, becomes malnourished
- Symptoms cramps, joint pain, tingling in legs
- Inherited
- No cure only gluten free diet