IGCSE BIOLOGY 0610 · CHAPTER 6 NOTES · ~10 MIN READ

Human nutrition

A balanced diet, scurvy and rickets, the digestive system organ by organ, teeth, enzymes and bile, and how the villi absorb food — with the exact definitions examiners want.

Balanced diet | Digestive system | Digestion & enzymes | Absorption | Teeth

AS by Aiza Ma'am
mentorriyaz.in

No tag = **Core** (everyone) EXTENDED Extended only highlight = comes up again and again

Test yourself at the end

IN 30 SECONDS

- A **balanced diet** has carbohydrate, protein, fat, vitamins, minerals, fibre and water in the right amounts. **Scurvy** = lack of vitamin C; **rickets** = lack of vitamin D (or calcium).
- **Digestion** breaks large insoluble molecules into small soluble ones. **Physical** digestion: teeth, stomach churning, bile. **Chemical** digestion: enzymes **amylase, protease, lipase**.
- **Absorption** happens mostly in the **small intestine**, which has **villi**. **Assimilation** uses the food in the cells. **Egestion** removes undigested food.

BY THE END YOU CAN

- Name the components of a balanced diet, their uses and sources.
- Describe the causes and effects of scurvy and rickets.
- Identify the organs of the alimentary canal and state their functions.
- Describe the structure and functions of the types of tooth.
- State where amylase, protease and lipase are made and act, and what they produce.
- Explain how bile helps digestion. EXT
- Describe how the small intestine and villi are adapted for absorption. EXT

1 A balanced diet

What the body needs

CARBOHYDRATE	PROTEIN	FAT (LIPID)	VITAMINS
USE energy	**USE** growth and repair of cells	**USE** energy store, insulation	**USE** C: skin, gums D: bones
SOURCES rice, bread, potatoes	**SOURCES** fish, eggs, beans, meat	**SOURCES** butter, oils, nuts	**SOURCES** fruit, veg, dairy, sunlight

MINERALS	FIBRE	WATER
USE Ca: bones, teeth Fe: haemoglobin	**USE** keeps food moving (peristalsis)	**USE** solvent, transport, reactions in cells
SOURCES milk, cheese, red meat	**SOURCES** whole grains, vegetables	**SOURCES** drinks, fruit, vegetables

A balanced diet has the right amount of all seven

Seven components, their main use and some sources.

- **Carbohydrates** — energy. **Fats** — energy store and thermal insulation. **Proteins** — growth and repair of cells.
- **Vitamins and minerals** are needed in tiny amounts: vitamin **C** keeps skin and gums healthy; vitamin **D** helps the body absorb **calcium**; **calcium** is needed for bones and teeth; **iron** is needed to make **haemoglobin**.
- **Fibre** (mostly cellulose) is not digested, but it keeps food moving through the gut by **peristalsis**.
- **Water** is the **solvent** for chemical reactions, the main part of blood, and is needed to remove wastes.
- Energy needs depend on **age, activity level and pregnancy**. A teenager playing sport needs more than an adult with an office job.

Deficiency diseases

SCURVY
lack of VITAMIN C



bleeding gums, slow-healing wounds, loose teeth

prevent:
citrus fruit, tomatoes, peppers

RICKETS
lack of VITAMIN D (or calcium)



normal rickets

soft, weak bones in children (vitamin D helps absorb calcium)

prevent:
oily fish, eggs, dairy, sunlight on skin

Both are DEFICIENCY diseases: caused by missing nutrients

Scurvy and rickets are caused by lacking particular nutrients.

- **Scurvy** — lack of **vitamin C**. Gums bleed, wounds heal slowly. **Prevent** it with citrus fruit and fresh vegetables.
- **Rickets** — lack of **vitamin D** (or calcium). Bones are soft and bend, causing **bowed legs** in children. **Prevent** it with oily fish, eggs, dairy and sunlight.

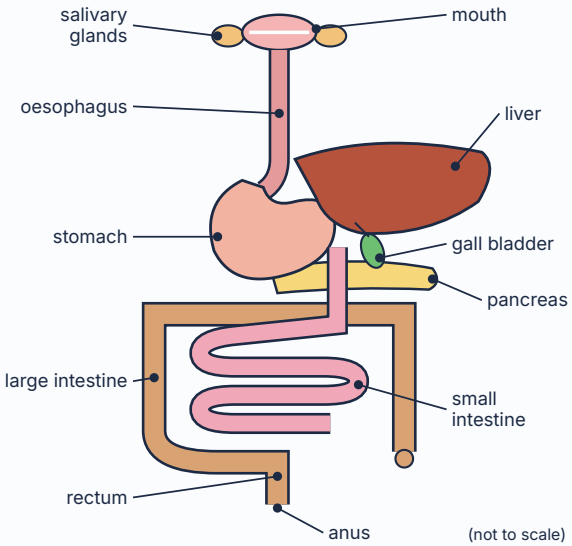
COMMON MISTAKE

"Scurvy is lack of vitamin D." **S**curvy goes with **C**: **sc**ur**vy** — vitamin **C**. **R**ickets goes with vitamin **D** (and calcium) for **bones**.

Aiza Ma'am

2 The digestive system

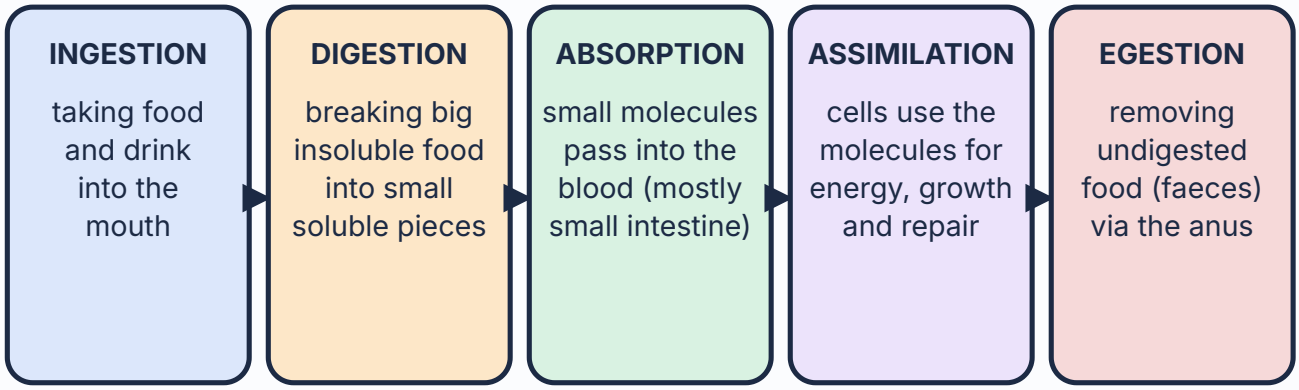
The alimentary canal



The alimentary canal is a long tube from mouth to anus. The liver, gall bladder and pancreas are associated organs.

Organ	Function
mouth	**ingestion**; teeth chew food (physical digestion); saliva contains **amylase**
oesophagus	carries food to the stomach by **peristalsis**
stomach	muscular wall **churns** food; **hydrochloric acid** kills bacteria; **protease (pepsin)** digests protein
liver	makes **bile**
gall bladder	**stores bile** and releases it into the small intestine
pancreas	makes **amylase, protease and lipase**, released into the small intestine
small intestine	**digestion** is finished here; **absorption** of digested food and most water
large intestine (colon)	**absorbs water**; the remaining waste becomes **faeces**
rectum and anus	rectum **stores faeces**; **egestion** through the anus

Aiza Ma'am



Digestion = physical (teeth, churning) + chemical (enzymes)

Egestion is NOT excretion: faeces were never part of body cells

The five stages of nutrition in animals.

Ingestion — taking substances (food and drink) **into the body** through the mouth.

Digestion — the **breakdown of large, insoluble food molecules** into small, soluble molecules. It can be **physical** or **chemical**.

Absorption — the movement of digested food molecules through the wall of the intestine into the **blood or lymph**.

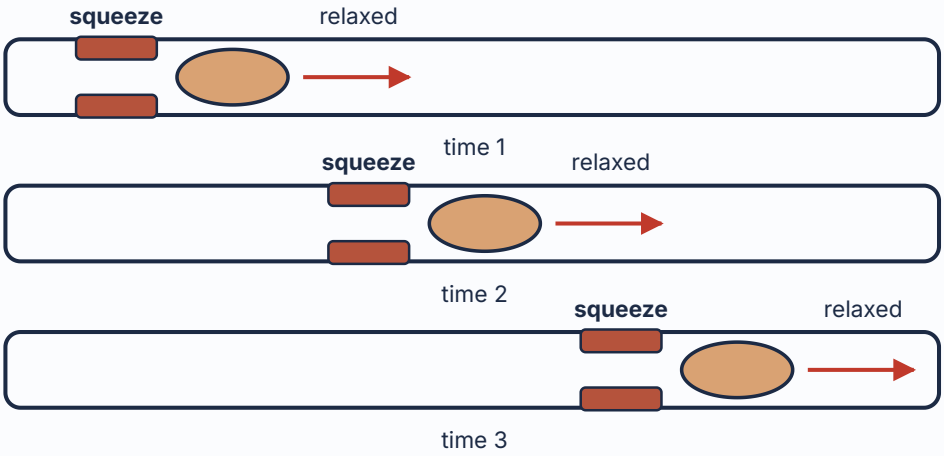
Assimilation — the movement of digested food molecules into the cells of the body, where they become part of the cells.

Egestion — the passing out of food that has **not been digested or absorbed** (faeces).

COMMON MISTAKE

Confusing **egestion** (undigested food leaving the gut) with **excretion** (waste made by cells, like urea and CO_2).

Peristalsis: waves of muscle contraction push food along the gut



circular muscles squeeze behind the food (bolus) · longitudinal muscles shorten the gut

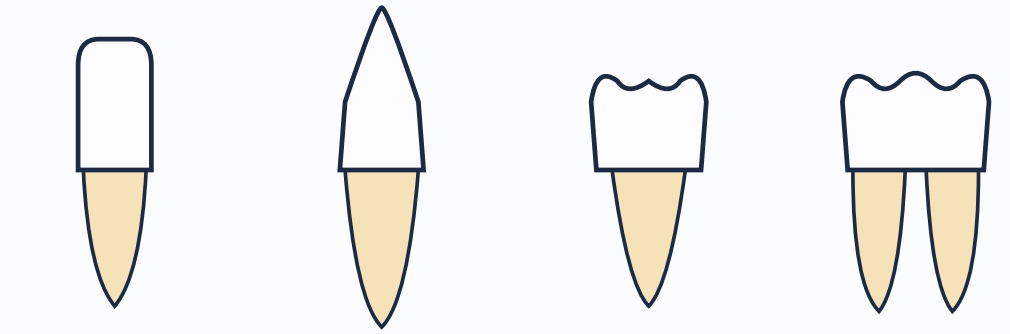
Waves of muscle contraction push food along the gut.

- **Peristalsis** moves food along the oesophagus and intestines. Circular muscles **squeeze behind** the food and relax in front of it.

3 Physical digestion

Teeth

Four types of tooth: different shapes, different jobs



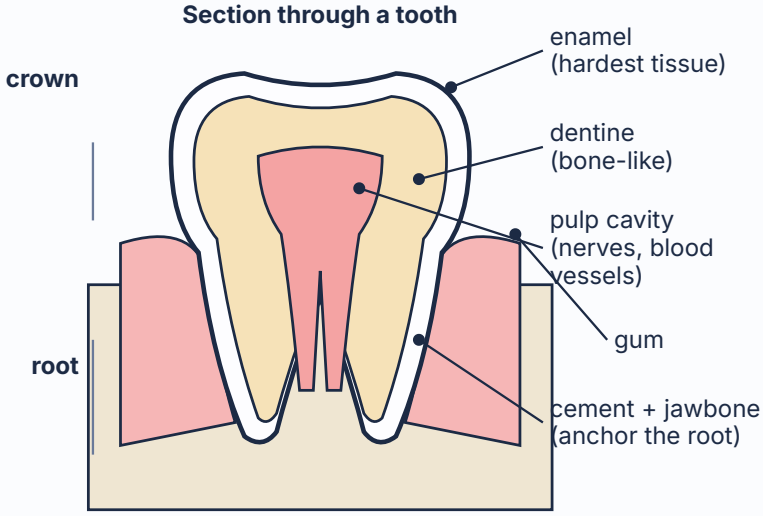
INCISOR	CANINE	PREMOLAR	MOLAR
cut and bite	tear and grip	crush and grind	crush and grind
front, chisel-shaped	pointed	2 bumps (cusps)	broad, 4+ cusps

Teeth chew food: this is PHYSICAL digestion (bigger surface area for enzymes)

Incisors cut, canines tear, premolars and molars crush and grind.

- Physical digestion **breaks food into smaller pieces**, giving a **larger surface area** for enzymes to work on.
- **Incisors** — cut and bite. **Canines** — tear and grip. **Premolars and molars** — crush and grind.

Section through a tooth



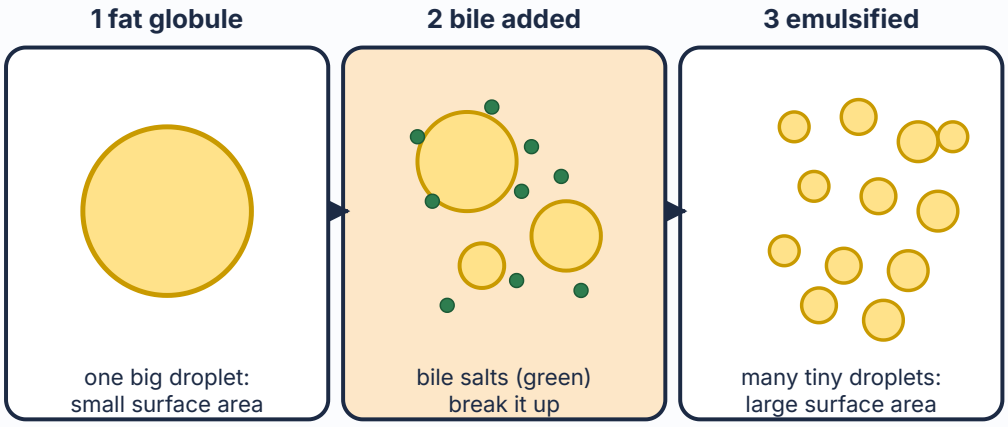
Sugar → bacteria make acid → acid dissolves enamel: decay

A tooth has a hard enamel coat, softer dentine, and a pulp cavity with nerves and blood vessels.

- **Enamel** — the hardest substance in the body: protects the tooth. **Dentine** — bone-like, softer. **Pulp cavity** — nerves and blood vessels. **Cement** — fixes the root into the jawbone.
- **Tooth decay:** bacteria in the mouth feed on sugar and make **acid**, which **dissolves the enamel**. Brushing, less sugar and fluoride reduce decay.

The stomach and bile

- The **stomach's muscular walls churn** food with gastric juice (acid and enzyme): more physical digestion.



Bile (made in the liver, stored in the gall bladder) does NOT contain enzymes

It emulsifies fat and is alkaline: it neutralises stomach acid in the small intestine

EXT Bile breaks large fat droplets into tiny ones. This is emulsification.

- EXT **Bile** is made in the **liver**, stored in the **gall bladder** and released into the small intestine. It has **no enzymes**.
- EXT Bile **emulsifies fats**: it breaks large globules into tiny droplets, giving a **larger surface area for lipase** to work on.
- EXT Bile is **alkaline**: it **neutralises the hydrochloric acid** from the stomach so that the pancreatic enzymes (optimum pH about 8) work properly.

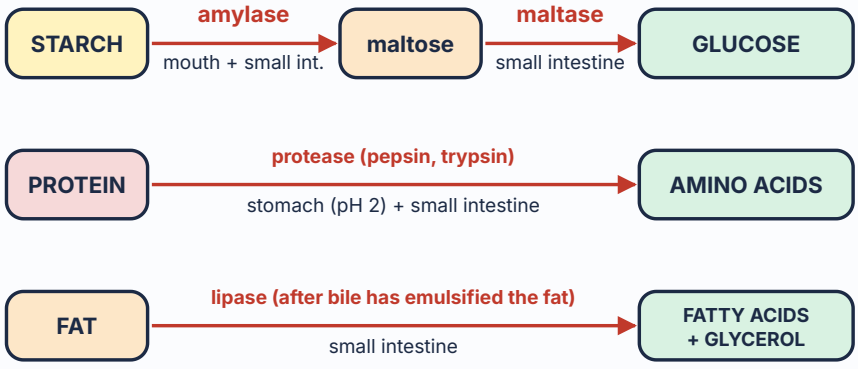
COMMON MISTAKE

"Bile digests fats." Bile does **not** digest (no enzymes). It only **emulsifies**. **Lipase** digests fats.

4 Chemical digestion

Enzymes and their products

enzyme (above the arrow) · where it works (below)



Large insoluble molecules → small soluble molecules that can be absorbed

Each enzyme is specific: amylase only starch, protease only protein, lipase only fat

Stomach acid (HCl) kills bacteria and gives pepsin its optimum pH of about 2

Three types of digestive enzyme and their end products. Each works on only one type of food.

Enzyme	Made in	Works in	Substrate → products
amylase	salivary glands, pancreas	mouth, small intestine	starch → **maltose**
maltase	wall of the small intestine	small intestine	maltose → **glucose**
protease (pepsin in the stomach)	stomach, pancreas	stomach, small intestine	protein → **amino acids**
lipase	pancreas	small intestine	fats → **fatty acids and glycerol**

- The **small intestine** receives juices from the **pancreas** and **bile** from the liver, so most chemical digestion is finished there.
- **Hydrochloric acid** in the stomach **kills bacteria** in food and gives the right acidity (**about pH 2**) for **pepsin**.

- EXT Digestion of starch happens in two steps: **amylase** makes **maltose**, then **maltase** makes **glucose**.

WORKED EXAMPLE

Follow a cheese sandwich (bread contains starch; cheese contains protein and fat). Name the enzymes and the products at each stage.

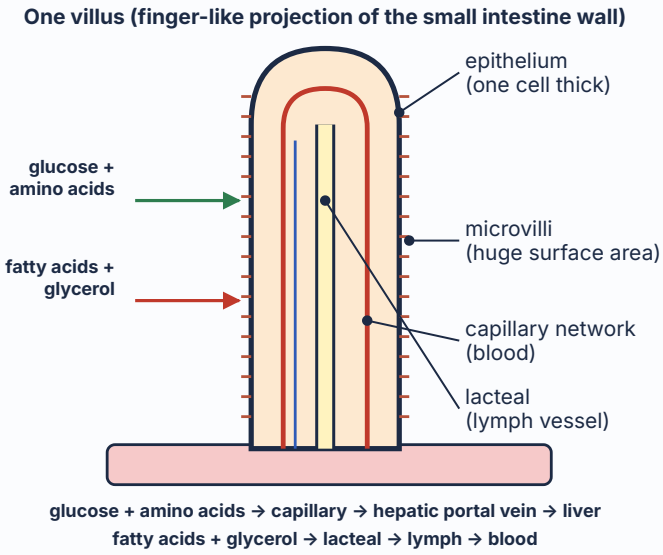
1. mouth: salivary **amylase** starts digesting starch into maltose
2. stomach: **pepsin (protease)** digests protein into smaller chains; acid kills bacteria
3. **small intestine: bile emulsifies fat, lipase makes fatty acids and glycerol, protease finishes protein to amino acids, amylase and maltase finish starch to glucose**

EXAM TIP

Quick recall: **A**mylase — **s**tarch; **P**rotease — **p**rotein; **L**ipase — **l**ipid. **Amylase → starch, Protease → protein, Lipase → lipid (fat).**

5 Absorption

The small intestine and villi



A villus. The wall is one cell thick and there is a rich blood supply.

- The small intestine is about **6 m long**. Its inner surface is covered in finger-like **villi**, and each villus cell has **microvilli**. This gives a **huge surface area**.
- Each villus has a **network of capillaries** (blood) and a **lacteal** (a lymph vessel).

Feature of the villus	How it helps absorption
huge surface area (villi + microvilli)	more room for absorption
wall one cell thick	short diffusion distance
rich blood supply (capillaries)	carries away absorbed food, keeping a **steep concentration gradient**
lacteal	absorbs **fatty acids and glycerol**

- **Glucose and amino acids** pass into the **capillaries** by diffusion and **active transport**, then go to the **liver** in the **hepatic portal vein**.
- **Fatty acids and glycerol** pass into the **lacteal**.
- **Water** is absorbed in the **small intestine** and the **colon** (large intestine).

Aiza Ma'am

6 Test yourself

Test yourself — cover the answers first

QUICK CHECK

1. Name the nutrient needed for growth and repair.
2. What deficiency disease is caused by lack of vitamin C?
3. Which organ stores bile?
4. Name the enzyme that digests starch and the product.
5. Name the end products of protein digestion.
6. What is the function of hydrochloric acid in the stomach?
7. Define absorption.
8. EXT What is the function of bile?
9. EXT Name the vessel in a villus that absorbs fatty acids and glycerol.

EXAM-STYLE

10. Explain why chewing food helps digestion. [2]
11. Describe how the small intestine is adapted for absorption. [4]
12. EXT Explain why bile is needed for fat digestion, although it contains no enzymes. [3]
13. Name two food groups, a source and a function of each. [4]

Show answers

1. protein
2. scurvy
3. gall bladder
4. amylase; maltose
5. amino acids
6. kills bacteria and gives the right pH for pepsin
7. movement of digested food molecules through the wall of the intestine into the blood or lymph
8. emulsifies fats and neutralises stomach acid
9. lacteal
10. breaks food into smaller pieces
    larger surface area for enzymes
11. very long, folded with villi and microvilli
    large surface area
    wall one cell thick: short diffusion distance
    good blood supply to carry food away
12. bile emulsifies fat into small droplets
    larger surface area for lipase
    bile is alkaline so it provides the right pH for lipase
13. e.g. protein: fish — growth and repair
    carbohydrate: rice — energy

Stuck on a question?

Send it to us on WhatsApp. We read every message.

Want regular help? Send this to your parent →

Share with a friend

Ask on WhatsApp

Aiza Ma'am