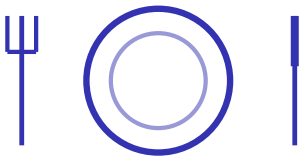


Human Nutrition

IGCSE Biology ■ Topic 7

IGCSE Biology



What we will cover

- 1 A balanced diet
- 2 The digestive system
- 3 Teeth & physical digestion
- 4 Enzymes & chemical digestion
- 5 Stomach acid & bile
- 6 Absorption & villi



teeth and physical digestion



A balanced diet



- too little vitamin C → **scurvy** (bleeding gums, slow healing).
- too little vitamin D → **rickets** (soft, bent bones), because the body cannot take in enough calcium.

Seven parts of a balanced diet

Carbohydrates

Carbohydrates for energy – the everyday fuel.

Fats and proteins

Fats are the energy *store* and insulate; **proteins** are for growth and repair.

Vitamins

Small amounts, specific jobs: vitamin C for connective tissue, vitamin D for calcium uptake.

Mineral ions

Mineral ions : calcium for bones and teeth, and **iron** – from red meat and leafy greens – to make **haemoglobin** , the red pigment that carries oxygen.

Fibre and water

Fibre gives the gut muscles something to push against; water is the solvent everything else travels in.

“Balanced” means all seven, in the right proportions for that person’s age, sex and activity – not simply enough food.

Vitamins and deficiency

vitamin C

fruit & veg; shortage → **scurvy**

vitamin D

helps absorb calcium;
shortage → **rickets**

The two deficiency diseases the syllabus names

scurvy

too little **vitamin C**: bleeding gums, and cuts that heal slowly

the source

fresh fruit and vegetables

rickets

too little **vitamin D** (or calcium): soft, weakened bones that bend under the body's weight

the source

dairy, oily fish, and sunlight on the skin

fats and oils

butter, oil, nuts – an **energy store**, and they help keep you warm

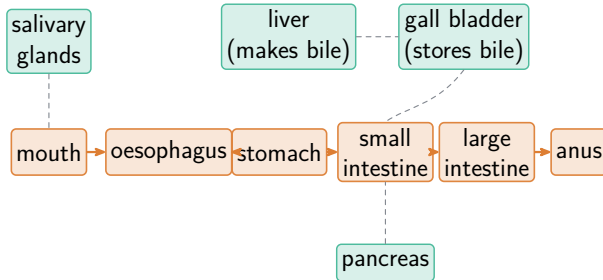
fibre

not digested; it gives the gut muscles something to push against, preventing constipation

Both diseases are named in the syllabus with their vitamin *and* their symptoms. A question giving symptoms wants the vitamin, and one giving the vitamin wants the symptoms.



The digestive system



→ food's path - - juices added

Food travels the **alimentary canal** : mouth → **oesophagus** → **stomach** → **small intestine** → **large intestine** . The **liver** , **pancreas** & glands add juices.

The route, end to end

Mouth to stomach

Mouth → **oesophagus** → **stomach** , which makes hydrochloric acid as part of the **gastric juice** .

Small intestine

The **duodenum** , then the **ileum** : where most digestion finishes and **nutrients** are absorbed.

Large intestine

The **colon** takes back water; the **rectum** stores the waste and the **anus** releases it.

At the wall

Maltase sits on the membranes of the **epithelium** lining the small intestine and breaks maltose into **glucose** right where it is absorbed.

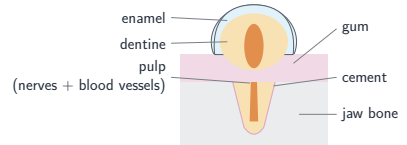
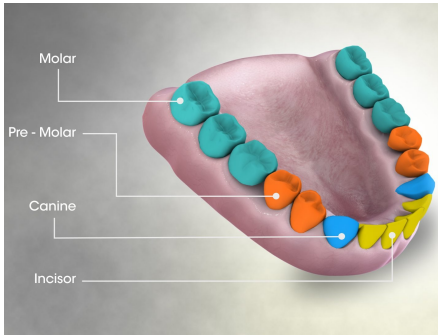
Amylase breaks starch into **reducing sugars** ; the last step happens at the wall, not in the cavity.

Five processes



Take in → break down → into blood → used by cells → waste out. **Egestion** (faeces) is **not** excretion.

Teeth and physical digestion



Incisors cut, **canines** tear, **premolars** & **molars** grind. A tooth: hard **enamel** over **dentine** , a soft **pulp** . Chewing makes more surface for enzymes.

The four kinds of tooth, and what a tooth is made of

incisors

chisel-shaped, at the front – **cutting** and biting

canines

pointed – **tearing**

premolars and molars

broad with ridges, at the back – **grinding** and chewing

enamel

the hard white outer layer – the **hardest material in the body**

dentine

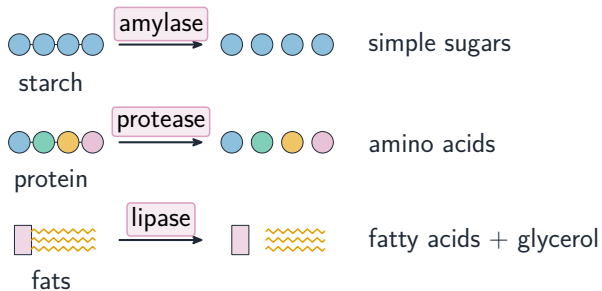
a softer, bone-like layer beneath the enamel

pulp and cement

the pulp holds nerves and blood vessels; the cement fixes the root into the jaw

Chewing is **physical** digestion: it does not change any molecule, it only increases the **surface area** for the enzymes to act on.

Enzymes and chemical digestion



Enzymes break big **insoluble** molecules into small **soluble** ones:

- **amylase** : starch → sugars
- **protease** : protein → amino acids
- **lipase** : fat → fatty acids + glycerol

Stomach acid and bile

stomach acid

hydrochloric acid

kills microbes & sets
a low pH for **pepsin**

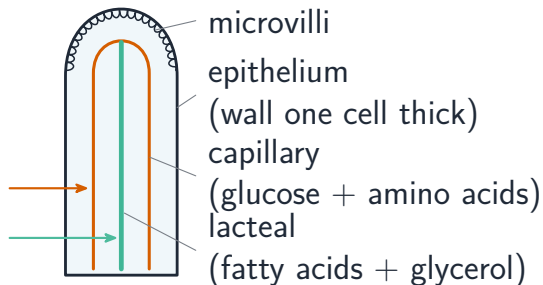
bile

emulsifies fat (more surface) & neutralises the acid

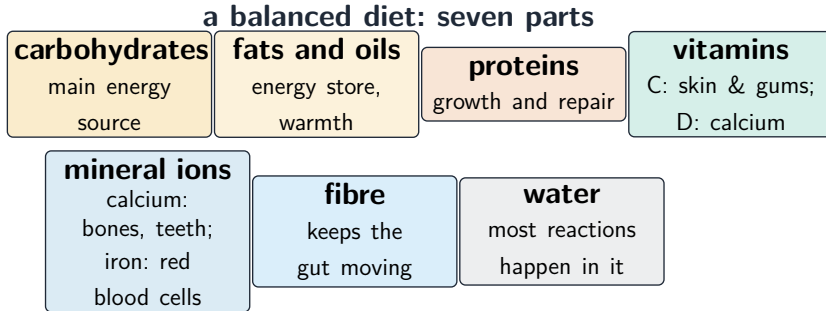
Absorption and villi

Millions of **villi** line the small intestine.

- huge **surface area**; wall one cell thick
- **capillaries** take glucose & amino acids
- a **lacteal** takes fats



A balanced diet, continued



the right **amounts** matter too - too much or too little each brings its own problems

The seven parts of a balanced diet and the job each one does

The digestive enzymes, and what each does

amylase

starch → maltose. Made in the **salivary glands** and **pancreas**

maltase

maltose → glucose. On the wall of the **small intestine** – so starch takes **two** steps

protease

protein → amino acids. **Pepsin** in the stomach, **trypsin** from the pancreas – again **two** proteases

lipase

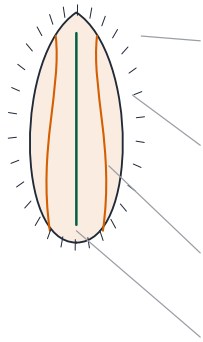
fats → fatty acids and glycerol. Made in the pancreas

bile

made in the liver, stored in the **gall bladder** . **Alkaline**, so it **neutralises** the acidic food entering the **duodenum** , and it **emulsifies** fat

Bile is **not** an enzyme. It does two physical jobs – change the pH, and break fat into droplets so lipase has more surface to work on.

Villi (Supplement)



microvilli: even more surface area

thin wall (one cell thick): a short path to the blood

rich blood supply: carries absorbed food away fast

a lacteal absorbs fats

millions of villi give a **huge surface area**, so absorption is fast

A villus is adapted for fast absorption: microvilli, a thin wall, a rich blood supply and a lacteal

Exam tips

- A balanced diet has the right amount of each part. Learn one source and one use for each.
- Vitamin C $\leftrightarrow$ scurvy; vitamin D $\leftrightarrow$ rickets.
- The five processes in order: ingestion $\rightarrow$ digestion $\rightarrow$ absorption $\rightarrow$ assimilation $\rightarrow$ egestion. Egestion (faeces) is **not** excretion.

Exam tips (continued)

- Physical digestion makes pieces smaller (more surface area); chemical digestion uses enzymes to make molecules smaller and soluble.
- amylase → sugars, protease → amino acids, lipase → fatty acids + glycerol. Stomach acid kills microorganisms and sets a low pH.
- Villi and microvilli give a large surface area, and a thin wall gives a short distance – both make absorption faster.



Worked example – matching enzyme to food

**A person's pancreas makes no lipase.
Which food is affected, and what is seen?**

- Lipase digests **fats**: fat → **fatty acids + glycerol**.
- No lipase ⇒ fat is not broken into small enough molecules to **absorb**.
- Undigested fat stays in the gut and passes out in the faeces.
- Starch and protein are unaffected – **amylase and protease still work**.

Three to know: **amylase**
starch → maltose; **protease** protein → amino acids; **lipase** fat → fatty acids + glycerol.

Topic 7 – key takeaways

1

Diet

vitamin C → scurvy; vitamin D
→ rickets

2

Processes

ingest, digest, absorb, assimilate,
egest

3

Enzymes

amylase, protease & lipase make
it soluble

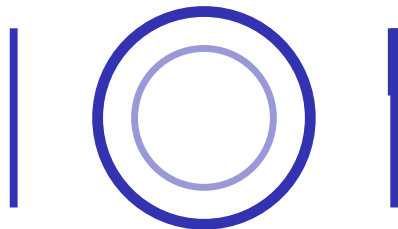
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Villi

big surface, thin wall – fast
absorption

Check yourself

- 1 Which deficiency causes scurvy?
- 2 Which process is NOT excretion: egestion or sweating?
- 3 What does lipase break fat into?
- 4 Why do villi have a thin wall?



Answers 1. too little vitamin C 2. egestion 3. fatty acids & glycerol 4. a short distance for fast absorption