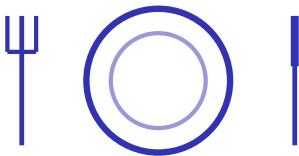


Human Nutrition

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



bite, tear, grind

teeth and physical digestion

1

Diet

A balanced diet



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

Seven parts of a balanced diet

Carbohydrates

Carbohydrates 碳水化合物 for energy – the everyday fuel.

Fats and proteins

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

Vitamins

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

Mineral ions

Mineral ions 矿物质离子: calcium for bones and teeth, and **iron** 铁 – from red meat and leafy greens – to make **haemoglobin** 血红蛋白, 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; short-
age → **scurvy** 坏血病

vitamin D

helps absorb calcium; short-
age → **rickets** 佝偻病

The two deficiency diseases the syllabus names

scurvy 坏血病

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

the source

fresh fruit and vegetables

rickets 佝偻病

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 脂肪 **and oils**

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

fibre 膳食纤维

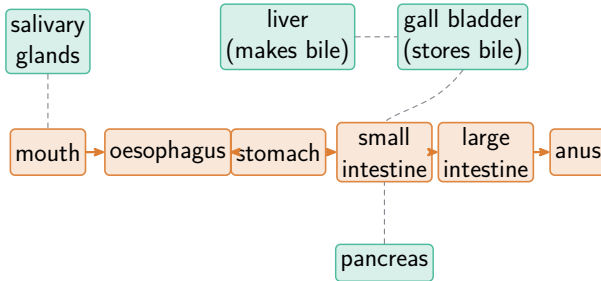
not digested; it gives the gut muscles something to push against, preventing constipation

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.

2

Digestion

The digestive system



→ food's path - - juices added

Food travels the **alimentary canal** 消化道: mouth → oesophagus 食道 → stomach 胃 → small intestine 小肠 → large intestine 大肠. The **liver** 肝脏, **pancreas** 胰腺 & glands add juices.

The route, end to end

Mouth to stomach

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

Small intestine

The **duodenum** 十二指肠, then the **ileum** 回肠: where most digestion finishes and **nutrients** 营养物质 are absorbed.

Large intestine

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

At the wall

Maltase 麦芽糖酶 sits on the membranes of the **epithelium** 上皮 lining the small intestine and breaks maltose into **glucose** 葡萄糖 right where it is absorbed.

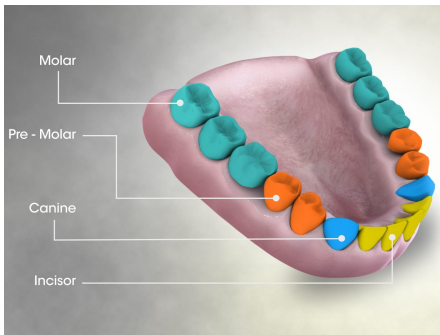
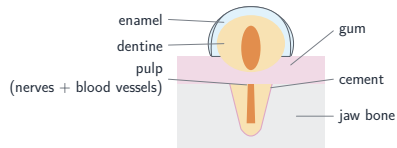
Amylase 淀粉酶 breaks starch into **reducing sugars** 还原糖; the last step happens at the wall, not in the cavity.

Five processes



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

Teeth and physical digestion



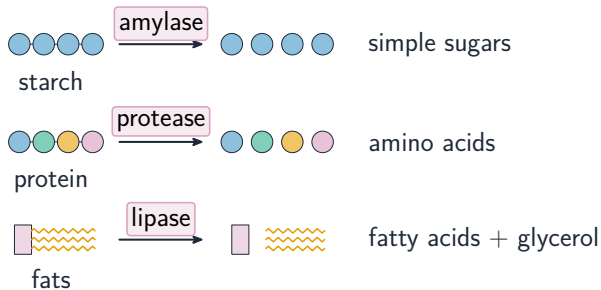
Incisors 门齿 cut, **canines** 犬齿 tear, **premolars** 前臼齿 & **molars** 臼齿 grind. A tooth: hard **enamel** 牙釉质 over **dentine** 牙本质, a soft **pulp** 牙髓. Chewing makes more surface for enzymes.

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 牙釉质	the hard white outer layer – the hardest material in the body
dentine 牙本质	a softer, bone-like layer beneath the enamel
pulp and cement 牙骨质	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** 不溶性 molecules into small **soluble** 可溶性 ones:

- **amylase** 淀粉酶: starch → sugars
- **protease** 蛋白酶: protein → amino acids
- **lipase** 脂肪酶: fat → fatty acids + glycerol

Stomach acid and bile

stomach acid

hydrochloric acid 盐酸
kills microbes & sets a low
pH for **pepsin** 胃蛋白酶

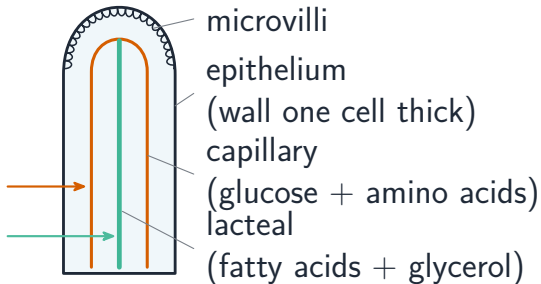
bile 胆汁

emulsifies 乳化 fat (more
surface) & neutralises the acid

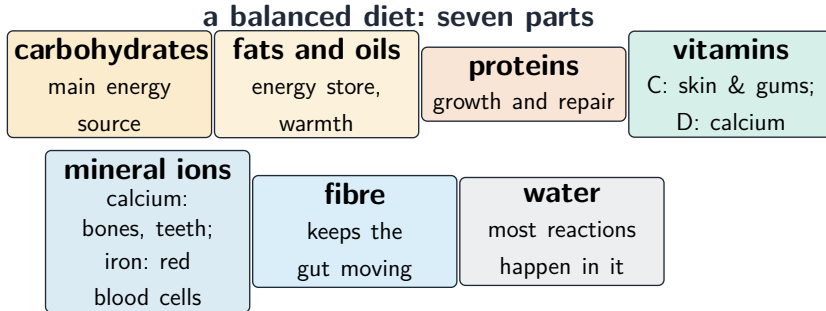
Absorption and villi

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

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



The seven parts of a balanced diet



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

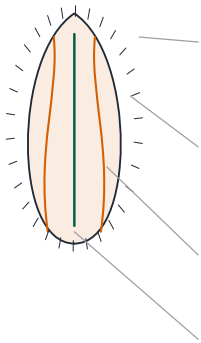
The seven parts of a balanced diet and the job each one does

The digestive enzymes, and what each does

amylase 淀粉酶	starch → maltose. Made in the salivary glands and pancreas
maltase 麦芽糖酶	maltose → glucose. On the wall of the small intestine 小肠 – so starch takes two steps
protease 蛋白酶	protein → amino acids. Pepsin 胃蛋白酶 in the stomach, trypsin 胰蛋白酶 from the pancreas – again two proteases
lipase 脂肪酶	fats → fatty acids and glycerol. Made in the pancreas
bile 胆汁	made in the liver, stored in the gall bladder 胆囊. Alkaline , so it neutralises 中和 the acidic food entering the duodenum 十二指肠, 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.

3

Recap

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; **pro-**
tease 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

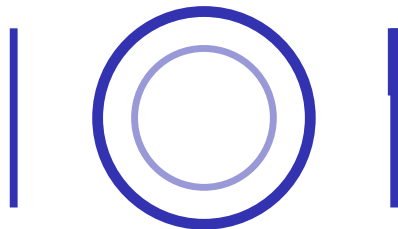
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Villi

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