

Human Nutrition

IGCSE Biology ■ Topic 7

IGCSE Biology



Human Nutrition

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

Human Nutrition

└ 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 <i>store</i> 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.

Human Nutrition

└ Diet

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

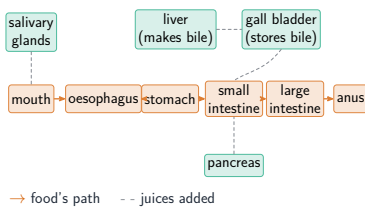
scurvy 坏血病	too little vitamin C : bleeding gums, and cuts that heal slowly
the source	fresh fruit and vegetables
rickets 佝偻病	too little vitamin D (or calcium): soft, weakened bones that bend under the body's weight
the source	dairy, oily fish, and sunlight on the skin
fats 脂肪 and oils	butter, oil, nuts – an energy store , and they help keep you warm
fibre 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

Human Nutrition
└ Digestion

The digestive system



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.

Human Nutrition
└ Digestion

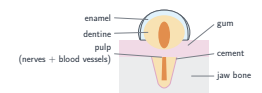
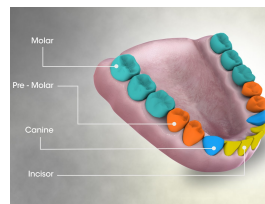
Five processes



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

Human Nutrition
└ Digestion

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.

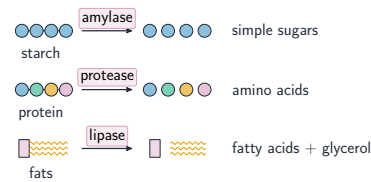
The four kinds of tooth, and what a tooth is made of

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.

Human Nutrition Digestion

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

Human Nutrition Digestion

Stomach acid and bile

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

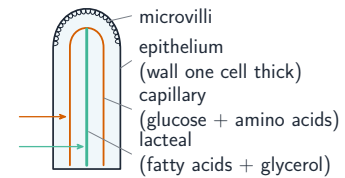
bile 胆汁
emulsifies 乳化 fat (more surface) & neutralises the acid

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Absorption and villi

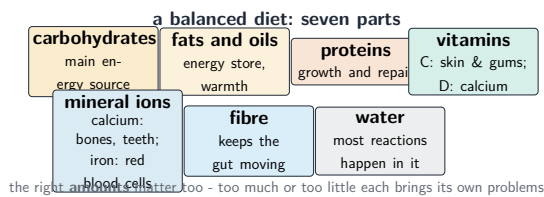
Millions of **villi** 绒毛 line the small intestine.

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



Human Nutrition Digestion

A balanced diet, continued

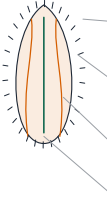


The seven parts of a balanced diet and the job each one does

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.

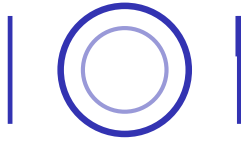
Human Nutrition └ Digestion	Human Nutrition └ Digestion
Villi (Supplement)	Exam tips
 microvilli: even more surface area thin wall (one cell thick): a short path to the blood rich blood supply: carries absorbed food away fast a lacteal absorbs fats millions of villi give a huge surface area, so absorption is fast A villus is adapted for fast absorption: microvilli, a thin wall, a rich blood supply and a lacteal	■ A balanced diet has the right amount of each part. Learn one source and one use for each. ■ Vitamin C → scurvy; vitamin D → rickets. ■ The five processes in order: ingestion → digestion → absorption → assimilation → egestion. Egestion (faeces) is not excretion.

Human Nutrition └ Digestion	Human Nutrition └ Digestion
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

Human Nutrition └ Recap	Human Nutrition └ Recap
Worked example – matching enzyme to food	Topic 7 – key takeaways
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.	1 Diet vitamin C → scurvy; vitamin D → rickets 2 Processes ingest, digest, absorb, assimilate, egest 3 Enzymes amylase, protease & lipase make it soluble 4 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