Human nutrition

IGCSE Biology

A balanced diet

A balanced diet includes plenty of fruit and vegetables.

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A **balanced diet** 均衡饮食 gives you all the substances you need, in the right amounts. There are seven parts.

Part of diet	Good sources	Why you need it
carbohydrates 碳水化合物	rice, bread, potatoes	the main source of **energy** 能量
fats 脂肪 and oils	butter, oil, nuts	an energy store; help keep you warm
proteins 蛋白质	meat, fish, eggs, beans	growth and repair of cells
vitamin 维生素 C	fresh fruit, vegetables	keeps skin and gums healthy
vitamin D	sunlight, oily fish, eggs	helps the body take in **calcium** 钙
mineral ions 矿物质离子—calcium	milk, cheese	strong bones and teeth
mineral ions —**iron** 铁	red meat, leafy greens	needed to make **red blood cells** 红细胞 that carry oxygen
fibre 膳食纤维 (roughage)	vegetables, whole grains	keeps food moving through the gut
water	drinks and food	needed for all reactions; most of the body is water

Two diseases come from missing a vitamin:

- 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.

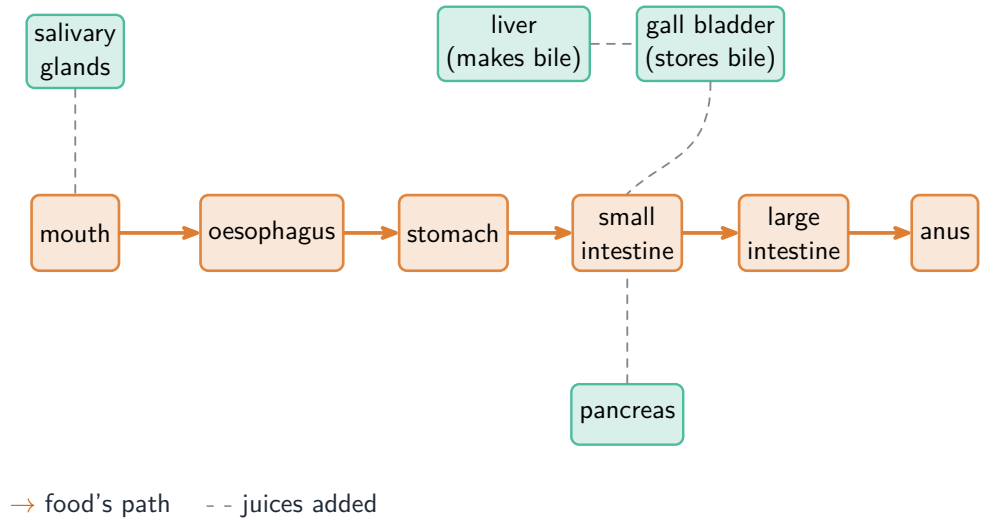
The digestive system

The **digestive system** 消化系统 breaks food down. Food passes along one long tube, the **alimentary canal** 消化道:

mouth → **oesophagus** 食道 → **stomach** 胃 → **small intestine** 小肠 (the **duodenum** 十二指肠 then the **ileum** 回肠) → **large intestine** 大肠 (the **colon** 结肠, **rectum** 直

肠 and **anus** 肛门).

Some organs help with digestion but food does not pass through them: the **salivary glands** 唾液腺 in the mouth, the **pancreas** 胰腺, the **liver** 肝脏 and the **gall bladder** 胆囊.



The alimentary canal that food passes through, plus the organs that add digestive juices

Five things happen to food, in order:

Process	What it means
ingestion 摄入	taking food and drink into the body through the mouth
digestion 消化	breaking food down into small molecules
absorption 吸收	**nutrients** 营养物质 move from the intestine into the blood
assimilation 同化	cells take in and use the nutrients
egestion 排遗	undigested food leaves the body as **faeces** 粪便

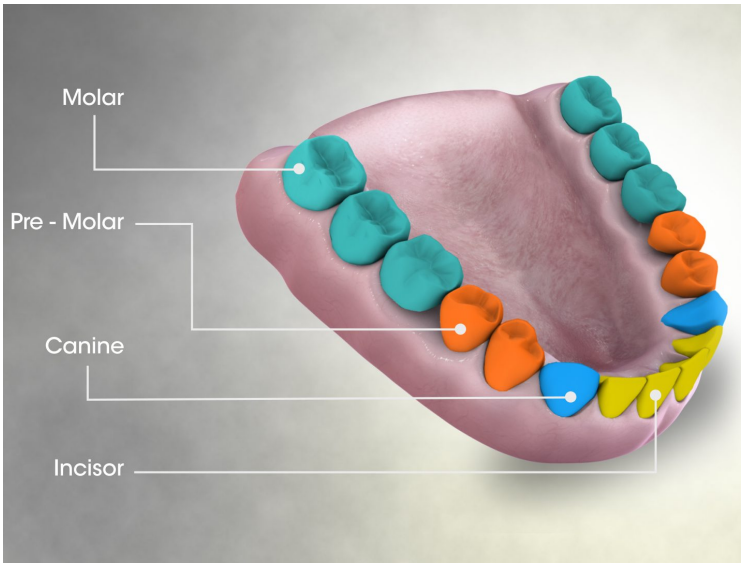
Physical digestion

Physical digestion breaks food into smaller pieces **without** changing the food molecules. This gives a larger **surface area** 表面积 for the **enzymes** 酶 to act on later.

Teeth

You have four kinds of **teeth** 牙齿:

Tooth	Job
incisors 门齿	sharp front teeth for biting and cutting
canines 犬齿	pointed teeth for tearing
premolars 前臼齿	flat teeth for chewing and grinding
molars 臼齿	flat back teeth for chewing and grinding



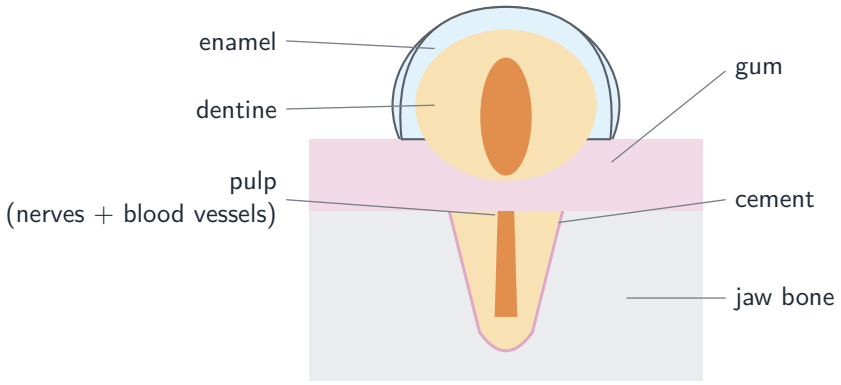
The four kinds of teeth: incisors and canines at the front, premolars and molars at the back

Image: http://www.scientificanimations.com/, CC BY-SA 4.0 (commons.wikimedia.org)

A tooth is built from these parts:

Part	Description
enamel 牙釉质	hard white outer layer; the hardest material in the body
dentine 牙本质	softer, bone-like layer under the enamel
pulp 牙髓	soft centre with **nerves** 神经 and **blood vessels** 血管
cement 牙骨质	fixes the root into the jaw

Teeth are set into the bone of the jaw and held firm by the **gums** 牙龈.



A tooth in section: hard enamel over dentine, a soft pulp, and a root set in the jaw

The stomach

The wall of the stomach is made of **muscle** 肌肉 that squeezes and mixes the food, breaking it into smaller pieces.

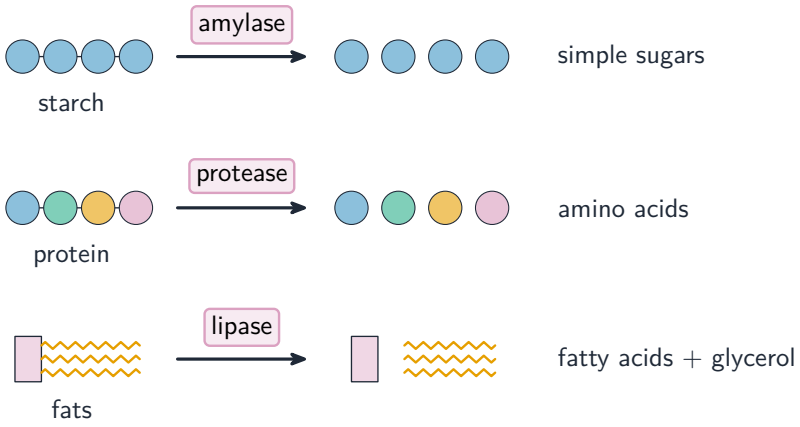
Bile (Supplement)

Bile 胆汁 is made in the liver and stored in the gall bladder. It **emulsifies** 乳化 fats and oils —it breaks large drops of fat into many tiny droplets. This gives a much larger surface area for the enzyme **lipase** 脂肪酶 to digest the fat. Bile itself contains no enzymes.

Chemical digestion

Chemical digestion breaks large **insoluble** 不溶性 molecules into small **soluble** 可溶性 molecules. Only small soluble molecules can be absorbed into the blood. Enzymes carry out this work.

Enzyme	Breaks down	Into	Made in
amylase 淀粉酶	**starch** 淀粉	**reducing sugars** 还原糖	salivary glands, pancreas
protease 蛋白酶	protein	**amino acids** 氨基酸	stomach, pancreas
lipase	fats and oils	**fatty acids** 脂肪酸 and **glycerol** 甘油	pancreas



Digestive enzymes break large insoluble molecules into small soluble ones

Acid in the stomach

The stomach makes **hydrochloric acid** 盐酸, which is part of the **gastric juice** 胃液. This acid:

- kills harmful **microorganisms** 微生物 in the food, and
- gives an **acidic** 酸性 pH, the best pH for the stomach's protease to work.

Digesting starch and protein (Supplement)

Starch is digested in two steps:

- amylase breaks starch into **maltose** 麦芽糖.
- **maltase** 麦芽糖酶, on the membranes of the **epithelium** 上皮 lining the small intestine, breaks maltose into **glucose** 葡萄糖.

Protein is digested by two proteases:

- **pepsin** 胃蛋白酶 breaks protein down in the acidic stomach.
- **trypsin** 胰蛋白酶 breaks protein down in the **alkaline** 碱性 small intestine.

Bile is alkaline. It **neutralises** 中和 the acidic food and gastric juice as they enter the duodenum, giving a suitable pH for the enzymes there.

Absorption

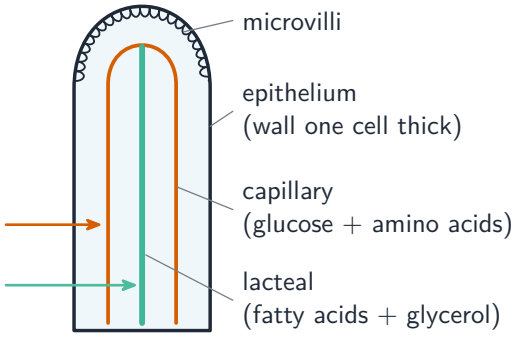
Digested nutrients are absorbed into the blood in the small intestine. Most water is absorbed here too; the colon absorbs the rest, leaving solid faeces.

Villi (Supplement)

The inside of the small intestine is covered with millions of tiny finger-shaped **villi** 绒毛. Each villus is itself covered in much smaller **microvilli** 微绒毛. Together these give a huge surface area, so absorption is fast.

A single villus has:

- a wall just one cell thick, so molecules have only a short distance to travel.
- a network of **capillaries** 毛细血管 that carry away absorbed glucose and amino acids.
- a **lacteal** 乳糜管 in the centre that carries away absorbed fatty acids and glycerol.



a villus (huge surface area for absorption)

A villus has a thin wall, a capillary network and a lacteal, for fast absorption

Exam tips

- 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.
- 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.