

Diet, the digestive system and physical digestion

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Read first: **Biological molecules**, **Organisation of the organism**

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What you need to know

This topic is tested on every paper, mostly as one-mark multiple-choice questions about nutrients, organs and teeth, and as parts of structured questions built around a diagram of the digestive system or a tooth. Only one outcome is **Extended only** (Papers 2 and 4). By the end of this topic you should be able to:

1. **Describe a balanced diet.**
2. **State the main food sources and describe the importance of** carbohydrates, fats and oils, proteins, vitamins C and D, the mineral ions calcium and iron, fibre (roughage) and water.
3. **State the causes of scurvy and rickets.**
4. **Identify the organs of the digestive system** in diagrams and photographs: the alimentary canal (mouth, oesophagus, stomach, small intestine with its duodenum and ileum, large intestine with its colon, rectum and anus) and the associated organs (salivary glands, pancreas, liver and gall bladder).
5. **Describe what each of those organs does**, using five terms: ingestion (taking food and drink into the body), digestion (breaking food down), absorption (nutrients moving from the intestines into the blood), assimilation (cells taking in and using nutrients) and egestion (removing undigested food from the body as faeces).
6. **Describe physical digestion:** breaking food into smaller pieces without any chemical change to the food molecules.
7. **State that physical digestion increases the surface area of food** for enzymes to act on in chemical digestion.
8. **Identify the four types of human teeth:** incisors, canines, premolars and molars.
9. **Describe the structure of a tooth:** enamel, dentine, pulp, nerves, blood vessels and cement, and know that teeth are held in the jaw bone and the gums.
10. **Describe what each type of tooth does** in physical digestion.
11. **Describe how the stomach does physical digestion.**
12. **Extended only:** outline how bile emulsifies fats and oils, increasing their surface area for chemical digestion.

The enzymes, hydrochloric acid, villi and absorption in detail are in the next topic, Chemical digestion and absorption.

Understand it

A balanced diet

Your body needs food for three things: **energy**, **growth and repair**, and **staying healthy**. No single food gives all of that. A **balanced diet** contains **all the nutrient groups** in the **right amounts (proportions)**, with **enough energy** for your needs.

There are seven components to know:

Component	Main sources	Why you need it
Carbohydrates (starch, sugars)	bread, rice, pasta, potatoes, cereals	the main source of energy , released in respiration
Fats and oils	butter, cheese, vegetable oil, nuts, oily fish	an energy store (about twice the energy per gram of carbohydrate); insulation against heat loss; protects organs ; part of cell membranes
Proteins	meat, fish, eggs, beans, lentils, milk	growth and repair of cells and tissues; making enzymes and antibodies
Vitamin C	citrus fruits (oranges, lemons), fresh fruit and vegetables	keeps gums and skin healthy; helps wounds heal
Vitamin D	oily fish, eggs, milk and butter (the skin also makes it in sunlight)	helps the body absorb calcium , for strong bones and teeth
Calcium (mineral ion)	milk, cheese, yoghurt, green vegetables	builds strong bones and teeth ; also needed for blood clotting
Iron (mineral ion)	red meat, liver, beans, spinach and other dark green vegetables	making haemoglobin in red blood cells, which carries oxygen
Fibre (roughage)	wholegrain bread and cereals, fruit, vegetables, beans	adds bulk, so the gut muscles can push food along ; prevents constipation
Water	drinks, and most foods	a solvent (reactions happen in solution); transport of substances, for example in blood plasma; helps remove wastes

Fibre is mostly cellulose from plant cell walls. Humans can't digest it, so it passes through the gut and is egested. That's why it gives bulk.

Deficiency diseases

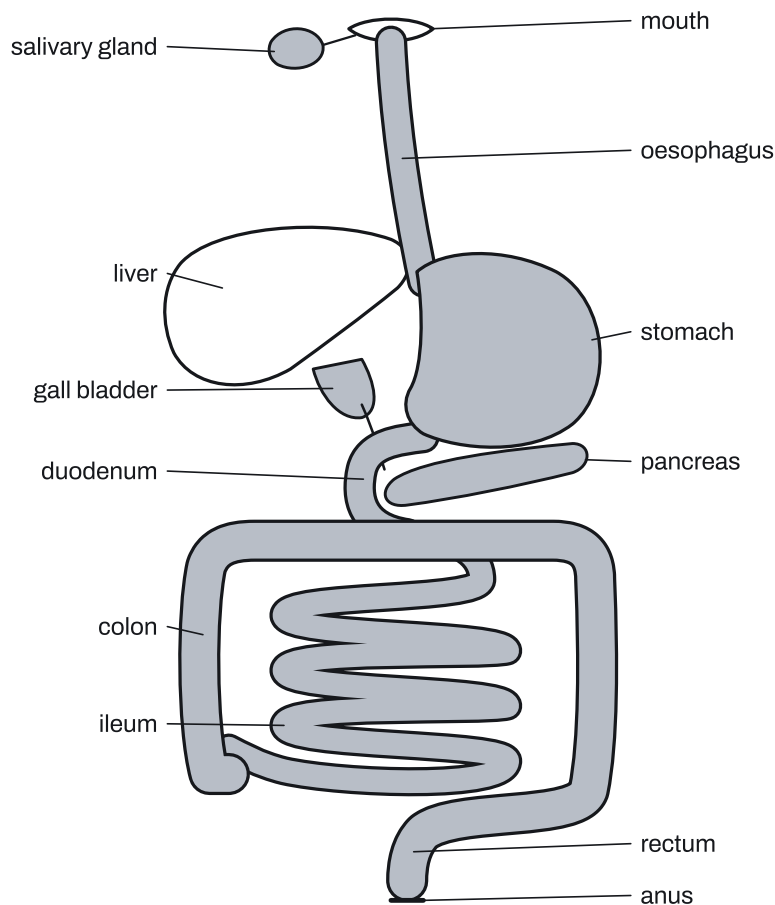
Too little of one nutrient over a long time causes a **deficiency disease**:

Lack of	Causes	Signs
Vitamin C	scurvy	swollen, bleeding gums; wounds that heal slowly
Vitamin D or calcium	rickets	soft, weak bones that bend (bowed legs) in children
Iron	anaemia	too little haemoglobin or too few red blood cells, so less oxygen is carried; tiredness
Fibre	constipation	food moves slowly through the gut; faeces are hard to egest

Remember the pairs: **C** → **scurvy**, **D (and calcium)** → **rickets**. Iron is linked to blood, not bones.

The digestive system

The **alimentary canal** is one long tube from mouth to anus. Food passes along it; the **associated organs** sit beside it and pour juices into it through ducts, but food never passes through them.



Food is dealt with in five stages, always in this order:

1. **Ingestion:** taking food and drink into the body, through the mouth.
2. **Digestion:** breaking food down, physically and chemically.
3. **Absorption:** small nutrient molecules moving from the intestines into the blood.
4. **Assimilation:** cells taking in the nutrients and using them, so they become part of the cells (for example, amino acids built into new proteins).
5. **Egestion:** removing undigested food, as faeces, through the anus.

Keep **absorption** (into the blood) apart from **assimilation** (into the cells and used), and **egestion** (undigested food that was never inside a cell) apart from **excretion** (waste made by the body's own chemical reactions, such as urea and carbon dioxide).

Organ	What it does
Mouth	ingestion; physical digestion by the teeth; chemical digestion of starch by amylase in saliva
Salivary glands	make saliva, which contains amylase and moistens food
Oesophagus	carries food from the mouth to the stomach (no digestion or absorption here)
Stomach	physical digestion by churning; chemical digestion of protein; makes hydrochloric acid

Organ	What it does
Small intestine: duodenum	the first part; digestion continues here, with pancreatic juice and bile added
Small intestine: ileum	the long second part; absorption of most nutrients and much of the water
Large intestine: colon	absorbs more water (and some mineral ions)
Large intestine: rectum	stores faeces
Large intestine: anus	egestion of faeces
Pancreas	makes pancreatic juice with enzymes (amylase, protease, lipase), which flows into the duodenum
Liver	makes bile ; also involved in assimilation (for example, amino acids made into proteins)
Gall bladder	stores bile , then releases it along the bile duct into the duodenum

Bile is **made** in the liver and **stored** in the gall bladder. The gall bladder does not make bile. The pancreas also makes the hormones insulin and glucagon, which belong to another topic.

Water is absorbed in **both** the small intestine and the colon. Most nutrients are absorbed in the **ileum**, which is why it is so long.

Physical digestion

Digestion is breaking down food. There are two kinds:

- **Physical digestion** (also called mechanical digestion) breaks food into **smaller pieces**, with **no chemical change** to the food molecules. A piece of cheese chewed into crumbs is still made of the same protein and fat molecules.
- **Chemical digestion** uses **enzymes** to break **large molecules into small molecules** (for example starch into sugars). The molecules themselves change.

Physical digestion matters because smaller pieces have a much **larger total surface area**. Enzymes can only work on the surface of a piece of food, so more surface means more enzyme action at once, and faster chemical digestion. For example, a 2 cm cube of food has a surface area of $6 \times 2^2 = 24 \text{ cm}^2$. Cut into eight 1 cm cubes, the total surface area is $8 \times 6 \times 1^2 = 48 \text{ cm}^2$; cut into 64 cubes of side 0.5 cm, it is 96 cm^2 . The volume of food is the same each time, but the area doubles with every halving of the side.

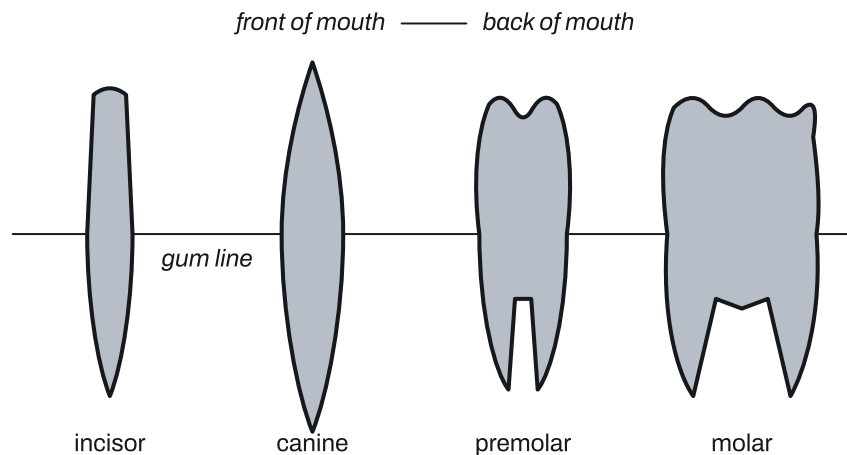
Physical digestion happens in:

- the **mouth**: the teeth cut and grind food, and the tongue mixes it with saliva;
- the **stomach**: its muscular walls contract to **churn** the food, breaking it into smaller pieces and mixing it with gastric juice until it is a thick liquid;
- **Extended**: the **small intestine**, where bile emulsifies fats (below).

On Core papers and in multiple choice, the places with **both** physical and chemical digestion are the **mouth** and the **stomach**; the oesophagus only moves food along, and the colon digests nothing. If a question offers the mouth and the duodenum, choose the **mouth** (0610/12/F/M/22 Q16). **Extended only:** on Paper 4 the small intestine is also accepted, because bile emulsifies fats there (0610/43/O/N/24 Q1).

Teeth

Adults have four types of teeth. In each half of each jaw, from the front: **2 incisors**, **1 canine**, **2 premolars**, **3 molars** (32 teeth in all).

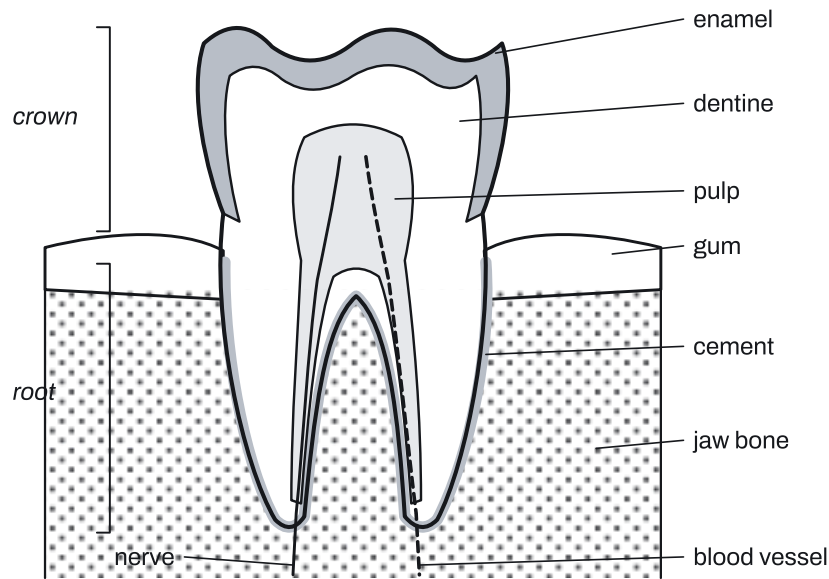


Tooth	Where and what it looks like	Function
Incisor	front; thin, flat, chisel-shaped edge; one root	biting and cutting food
Canine	beside the incisors; pointed; one long root	gripping , piercing and tearing food; also counts for biting and cutting
Premolar	behind the canine; broader, with two points (cusps); one or two roots	chewing , grinding and crushing
Molar	at the back; largest, flat grinding surface with several cusps; two or three roots	chewing , grinding and crushing

The front teeth bite off pieces; the back teeth grind them up.

The structure of a tooth

Each tooth has a **crown** above the gum and a **root** held in the jaw.



Part	What it is and does
Enamel	the hard outer layer covering the crown; the hardest substance in the body; protects the tooth and stands up to biting and grinding
Dentine	under the enamel, forming most of the tooth; hard, like bone, but softer than enamel
Pulp	soft tissue in the centre (the pulp cavity)
Nerves	in the pulp; detect pain, pressure and temperature
Blood vessels	in the pulp; bring oxygen and nutrients to the living cells of the tooth
Cement	a thin layer covering the root; helps fix the tooth into the jaw bone
Gum	soft tissue covering the jaw bone around the base of the crown
Jaw bone	the bone that the roots are embedded in

So teeth are embedded in **bone** and the **gums**, and the pulp holds the **nerves** and **blood vessels**.

Bile and emulsification (Extended only)

Fats and oils don't mix with water: in the watery contents of the small intestine they form large drops. **Bile** (made in the liver, stored in the gall bladder, released into the duodenum) **emulsifies** fats: it breaks large drops of fat into many **tiny droplets**. This is **physical** digestion: the fat molecules are not changed. It gives a much **larger surface area** for the enzyme **lipase** to act on, so fats are chemically digested faster.

Bile is **not an enzyme**, and it doesn't digest fat itself. (Bile also neutralises stomach acid; that is in Chemical digestion and absorption.)

Key facts and formulas

There is no formula list in the IGCSE Biology exam. Everything below must be learnt.

Formula	Status
Balanced diet: all the nutrient groups, in the right proportions, with enough energy	Learn it
Seven components: carbohydrates, fats, proteins, vitamins, mineral ions, fibre, water	Learn it
Vitamin C → gums, wound healing; lack → scurvy	Learn it
Vitamin D and calcium → bones and teeth; lack → rickets	Learn it
Iron → haemoglobin in red blood cells; lack → anaemia	Learn it
Fibre → moves food through the gut; lack → constipation	Learn it
Order: ingestion → digestion → absorption → assimilation → egestion	Learn it
Bile: made in the liver, stored in the gall bladder, released into the duodenum	Learn it
Physical digestion: smaller pieces, no chemical change, larger surface area for enzymes	Learn it
Incisors (and canines) bite and cut; canines grip and tear; premolars and molars chew and grind	Learn it
Tooth: enamel → dentine → pulp (nerves, blood vessels); cement on the root; in bone and gum	Learn it
Mass of nutrient in a portion = $\frac{\text{mass per 100 g}}{100} \times \text{mass of portion}$	Learn it
percentage of RDA = $\frac{\text{amount eaten}}{\text{RDA}} \times 100$	Learn it
Surface area of a cube of side $s = 6s^2$	Learn it

How to do it

In the questions we have tagged for this topic (141 questions, 2021–2025, on Papers 1–4), the types came up this often. 26 of the 141 questions mix types, so the counts add up to 185.

Question type	Questions
Link a nutrient to its source, importance or deficiency disease	52
Identify digestive organs and state their functions	37
Identify tooth types and state their functions	26
Describe physical digestion: what, where and why	19
Use diet data: food labels, RDA tables and graphs	15
Define or order ingestion, digestion, absorption, assimilation, egestion	12
Label the structure of a tooth	10
Define a balanced diet and list its components	9

Question type	Questions
Dental decay (older papers only)	3
Diet-related health risks and energy needs (older papers only)	2

Most are one-mark multiple choice on Papers 1 and 2. On Papers 3 and 4 they come as parts of a longer question, often starting from a diagram of the digestive system or a tooth.

1. Link a nutrient to its source, importance or deficiency disease (52 questions)

1. **Name the nutrient** the question is about and recall its row in the tables in "Understand it".
2. **Importance:** give what it does in the body, as specifically as you can: "iron is needed to make haemoglobin", not "iron is good for the blood".
3. **Deficiency:** give the disease and, if asked, its signs.

Variations you will meet:

- **"Which nutrient is lacking in scurvy?"** Vitamin C. **"Which nutrients prevent rickets?"** Calcium and vitamin D. This pair is the most common one-mark question in the topic.
- **Signs given, find the nutrient:** bleeding gums and slow wound healing → vitamin C; low haemoglobin or tiredness → iron; weak, bent bones → vitamin D or calcium; constipation → fibre.
- **"Describe the importance of vitamins and minerals"** (up to 4 marks): one mark per named nutrient and its job, plus the disease it prevents. For example: vitamin C for healthy gums (**1**), prevents scurvy (**1**); iron to make haemoglobin in red blood cells (**1**), prevents anaemia (**1**).
- **"State the importance of fat":** an energy store, insulation or protecting organs; any one scores.
- **Sources:** which food is a good source of vitamin C (oranges), fibre (beans, wholegrain bread, vegetables), fat (cheese, vegetable oil), calcium (milk, cheese). Meat, eggs, fish and cheese contain no fibre.
- **"Which component can be broken down to release energy?"** Carbohydrates and fats (and proteins); not vitamins, mineral ions, fibre or water.
- **"Circle two uses of water in the body":** as a solvent and for transport.
- **A plant-only diet:** it will not lack fibre. It can be low in protein unless it includes beans, lentils or nuts.
- **Extended "explain" questions** want a linked chain: "less iron (**1**) → less haemoglobin (**1**) → less oxygen carried to cells (**1**) → less respiration, so tiredness (**1**)".

2. Identify digestive organs and state their functions (37 questions)

1. **Find the mouth and follow the tube:** mouth → oesophagus → stomach (a J-shaped bag on the body's left) → duodenum (a short C-shaped loop) → ileum (the long coils) → colon (the wide tube framing the coils) → rectum → anus.
2. **The organs off the tube:** the **liver** is the big organ on the body's right, just below the diaphragm; the **gall bladder** is the small sac under it; the **pancreas** is the thin organ below the stomach, in the curve of the duodenum; the **salivary glands** are beside the mouth.
3. **Match the organ to its job** from the table in "Understand it".

Variations you will meet:

- **"Where does egestion (or ingestion) take place?"** The anus (or the mouth).
- **"Where is bile made? Where is it stored?"** Liver; gall bladder. Don't write "bile duct" or "bladder".
- **"Which organ releases hydrochloric acid?"** The stomach. **"Which organ secretes protease and amylase?"** The pancreas (salivary glands make amylase only). **"Which organ secretes insulin?"** The pancreas.
- **"Which function is performed in the duodenum?"** Digestion. The ileum is the main site of absorption.
- **"Name the parts of the small intestine":** duodenum and ileum. **"Of the large intestine":** colon, rectum and anus. The oesophagus is part of neither.
- **"Which organs are part of the digestive system?"** Rule out organs from other systems: lungs, larynx, kidney, ureter, uterus, vena cava.
- **Where water is absorbed:** small intestine **and** colon.
- **A table to complete** (Paper 4): letter, name and function for each row, for example "L, gall bladder, stores bile". Every column must be right for the mark.
- **Another mammal's gut** (a cat, for example) has the same parts in the same places.

3. Identify tooth types and state their functions (26 questions)

1. **Use the shape:** chisel edge → incisor; single point → canine; two cusps → premolar; broad flat top with several cusps → molar.
2. **Use the position:** front → incisors; then canines; back → premolars, then molars.
3. **Function:** incisors bite and cut; canines grip, pierce and tear; premolars and molars chew, grind and crush.

Variations you will meet:

- **"Which teeth grind food?"** Premolars and molars. Incisors don't grind.
- **"Which teeth bite and cut?"** Incisors **and** canines. Canines count in multiple choice too: the answer to [0610/23/O/N/23 Q13](#) is "incisors and canines".
- **"State the names and functions of two types of teeth"** (Paper 4, 2 marks): one mark each for a correct name with its function.
- **"Identify the tooth in this section and explain how you chose":** molar, because it has a large, flat grinding surface or more than one root.
- **A jaw from above:** count from the middle outwards: two incisors, one canine, two premolars, three molars on each side.
- **A skull with no canines** (a sheep, for example): the animal is a herbivore, grinding plants, so it doesn't need teeth for tearing meat.

4. Describe physical digestion: what, where and why (19 questions)

1. **What it is** (2 marks): the breakdown of food into smaller pieces (**1**) without chemical change to the food molecules (**1**).
2. **Where**: the mouth (teeth) and the stomach (churning). On Core papers and in multiple choice, the organs with both physical and chemical digestion are the mouth and the stomach: pick the mouth over the duodenum. **Extended only**: Paper 4 also accepts the small intestine (bile emulsifying fats).
3. **Why it helps**: it increases the surface area of the food (**1**) for enzymes to act on (**1**), so chemical digestion is faster.

Variations you will meet:

- **"Describe the function of the stomach in physical digestion"**: its muscular wall contracts to churn and mix the food, breaking it into smaller pieces.
- **Matching sentences**: physical digestion "breaks food into smaller pieces"; chemical digestion "breaks down food molecules", "involves chemical changes" and "involves enzymes".
- **"Physical digestion takes place in the mouth only"** is a trap. It also happens in the stomach.
- **"What increases the surface area of food for enzymes?"** Physical digestion (not absorption or respiration).
- **"Why does chewing speed up digestion?"** It increases the surface area of the food.
- **Extended: "Explain the role of bile"** (3 marks): bile emulsifies fats (**1**) into small droplets, increasing their surface area (**1**) for lipase to act on, so chemical digestion of fat is faster (**1**).
- **Extended longer questions** ask you to describe food's journey from mouth to stomach and how it is broken up: teeth cut and grind, the tongue and saliva form it into a ball, the oesophagus carries it down, the stomach churns it; each step increases the surface area for enzymes.

5. Use diet data: food labels, RDA tables and graphs (15 questions)

1. **Scale label values to the portion**: label values are usually per 100 g. For 150 g of yoghurt with 4.0 g of protein per 100 g, protein = $4.0 \times \frac{150}{100} = 6.0$ g. If the person needs 50 g, they still need $50 - 6.0 = 44$ g.
2. **Compare intake with the RDA** (recommended daily amount): any nutrient eaten **below** its RDA can lead to its deficiency disease; nutrients at or above it are fine.
3. **Show the working and give units**. Round only at the end, as the question asks.

Variations you will meet:

- **Tablets needed for an RDA**: find the amount in one tablet first. A 4 g tablet of a supplement with 45 mg of iron per 100 g contains $45 \times \frac{4}{100} = 1.8$ mg. For an RDA of 14 mg: $14 \div 1.8 = 7.8$ tablets (1 d.p.).
- **Mass of food needed for an RDA**: a food with 16 g of protein per 100 g, for an RDA of 56 g: $56 \div 16 \times 100 = 350$ g.
- **Percentage of the RDA**: 3.2 mg of iron out of an RDA of 14 mg is $\frac{3.2}{14} \times 100 = 22.9\%$.

- **Which food is best to prevent scurvy (or rickets)?** Pick the one with the most vitamin C (or vitamin D and calcium) in the table.
- **Which food gives the most energy?** The one with the most fat, since fat releases about twice as much energy per gram as carbohydrate or protein.
- **Describe a bar chart:** the overall pattern, then data quotes with units, for example "the percentage fell from 30% to 18% in country B".
- **"State two components of a balanced diet missing from this label":** compare the label with the seven components. Name groups (vitamins, water), not two different vitamins.

6. Define or order the five stages (12 questions)

1. Learn the five definitions in "Understand it" and their order: **ingestion** → **digestion** → **absorption** → **assimilation** → **egestion**.
2. In a matching question, find the key words: "taken into the body" → ingestion; "broken down" → digestion; "into the blood" → absorption; "into cells, used, become part of the cells" → assimilation; "undigested, faeces, anus" → egestion.

Variations you will meet:

- **"Food molecules move into cells, where they are used and become part of the cells"** is assimilation, not absorption. Examiners say this is the most common error in the topic.
- **"Removal of material from the rectum"** is egestion, never excretion.
- **Fill-in sentences:** "The process of taking food into the mouth is called **ingestion**."

7. Label the structure of a tooth (10 questions)

1. **Work from the outside in:** enamel (over the crown) → dentine → pulp in the middle.
2. **Below the gum:** cement covers the root, which sits in the jaw bone; the gum covers the bone.
3. **Inside the pulp:** nerves and blood vessels.

Variations you will meet:

- **"Which layer is dentine?"** The layer directly under the enamel, making up most of the tooth.
- **"State two structures inside the pulp":** nerves and blood vessels.
- **"Which two parts of the mouth are teeth embedded in?"** The gums and the (jaw) bone.
- **Complete the labels from a list,** or draw label lines ending exactly on each layer.

8. Define a balanced diet and list its components (9 questions)

1. **Definition** (2 marks): all the nutrient groups (**1**), in the correct proportions or amounts (**1**); "enough energy" is also credited.
2. **Components:** carbohydrates, fats, proteins, vitamins, mineral ions, fibre and water.

Variations you will meet:

- **"Explain why this food is part of a balanced diet"**: say which groups it contains and what each does. Don't claim it has everything "in the right proportions" unless the data show it.
- **"State two other components of a balanced diet"**: any two groups not already named in the question.

9. Dental decay (3 questions, older papers only)

Papers from 2021 and 2022 asked how teeth decay and how to prevent it. That is **not in the current syllabus**, so it won't be asked again.

10. Diet-related health risks and energy needs (2 questions, older papers only)

Papers from 2021 and 2022 asked about the effects of too much fat (such as obesity and heart disease) and why energy needs differ between groups of people. These are **not in the current syllabus for this topic**. A bar chart of energy needs could still appear as data to describe: read the values carefully and quote them with units.

Worked examples

The bold codes show where marks are earned, as in Cambridge mark schemes. The number is how many marks.

- **M1** method mark: for a correct method, even if the numbers slip.
- **A1** accuracy mark: for a correct answer; it needs the M mark before it.
- **B1** mark for a correct result on its own, with no method needed.

Example 1

A teenager records what she eats in one day. The table shows her intake of four nutrients and her recommended daily amount (RDA).

Nutrient	RDA	Amount eaten
Vitamin C / mg	40	30
Vitamin D / µg	10	15
Calcium / mg	1000	1300
Iron / mg	15	6

(a) Describe what is meant by a balanced diet. **[2]**

(b) Name the two deficiency diseases she is at risk of if she eats like this for a long time. Explain your answer. **[3]**

- (c) Calculate the amount of iron she eats as a percentage of her RDA. [2]
- (d) Suggest one food she could add to her diet for each nutrient she lacks. [2]
- (a) A diet containing all the nutrient groups **B1** in the correct proportions (with enough energy) **B1**.
- (b) Scurvy **B1** and anaemia **B1**. Her vitamin C (30 mg) and iron (6 mg) are both below the RDA, while vitamin D and calcium are above it **B1**.
- (c) $\frac{6}{15} \times 100$ **M1** = 40% **A1**.
- (d) Vitamin C: oranges (or other citrus fruit, fresh vegetables) **B1**. Iron: red meat, liver, beans or spinach **B1**.

Example 2

- (a) Name the organ where each of these happens:
- ingestion
 - bile is made
 - bile is stored
 - most nutrients are absorbed
 - egestion [5]
- (b) State the term for the uptake and use of nutrients by cells. [1]
- (c) A tooth has a large, flat top and three roots. Name this type of tooth, and describe its function. [2]
- (d) State the name of the hard layer covering the crown of a tooth, two structures found in the pulp, and the layer that covers the root. [4]
- (a) Mouth **B1**; liver **B1**; gall bladder **B1**; small intestine (ileum) **B1**; anus **B1**.
- (b) Assimilation **B1**.
- (c) Molar **B1**; chewing and grinding food **B1**.
- (d) Enamel **B1**; nerves **B1** and blood vessels **B1**; cement **B1**.

Example 3

A breakfast cereal label shows this information per 100 g.

Carbohydrate	Protein	Fat	Fibre	Iron
68 g	9.5 g	2.0 g	11 g	12 mg

A student eats a 40 g serving of the cereal with 125 cm³ of milk. The milk contains 3.6 g of protein per 100 cm³.

- (a) Calculate the total mass of protein in the student's breakfast. [3]

- (b) The student's RDA for iron is 15 mg. Calculate the percentage of the RDA provided by one serving of cereal. **[2]**
- (c) State two components of a balanced diet that are not shown on the label. **[2]**
- (d) Explain why the fibre in this cereal is important in the diet. **[2]**
- (a) Cereal: $9.5 \times \frac{40}{100} = 3.8 \text{ g}$ **M1**. Milk: $3.6 \times \frac{125}{100} = 4.5 \text{ g}$ **M1**. Total = 8.3 g **A1**.
- (b) Iron in the serving = $12 \times \frac{40}{100} = 4.8 \text{ mg}$; $\frac{4.8}{15} \times 100$ **M1** = 32% **A1**.
- (c) Vitamins **B1** and water **B1**. (Iron is a mineral ion, so minerals are already on the label.)
- (d) Fibre adds bulk to the food, so the muscles of the gut can push it along **B1**; this prevents constipation **B1**.

Example 4

Extended.

- (a) Describe what is meant by physical digestion. **[2]**
- (b) Describe the role of the stomach in physical digestion. **[2]**
- (c) A 3 cm cube of cheese is chewed into cubes of side 0.5 cm. Calculate the total surface area before and after chewing, and use your answer to explain why chewing speeds up digestion. **[4]**
- (d) Outline the role of bile in the digestion of fats. **[3]**
- (a) The breakdown of food into smaller pieces **B1** without chemical change to the food molecules **B1**.
- (b) The muscles in the stomach wall contract to churn the food **B1**, breaking it into smaller pieces and mixing it with gastric juice **B1**.
- (c) Before: $6 \times 3^2 = 54 \text{ cm}^2$ **B1**. Number of small cubes = $\left(\frac{3}{0.5}\right)^3 = 216$, each with area $6 \times 0.5^2 = 1.5 \text{ cm}^2$, so the total is $216 \times 1.5 = 324 \text{ cm}^2$ **M1 A1**, six times as much. The larger surface area gives enzymes more food to act on at once, so chemical digestion is faster **B1**.
- (d) Bile emulsifies fats **B1**, breaking large drops into many small droplets **B1**, which increases the surface area for lipase to act on, so fats are chemically digested faster **B1**.

Common mistakes

- **Calling assimilation "absorption"**. Absorption is into the blood; assimilation is into the cells, where the nutrients are used. Examiner reports mention this swap almost every year.
- **Writing "excretion" for the removal of faeces**. Undigested food leaves by **egestion**. Excretion removes waste made by the body's own reactions.

- **Mixing up vitamin C and vitamin D.** C → gums, scurvy; D → bones and teeth, rickets. Scurvy is not caused by a lack of iron.
- **Describing anaemia instead of what iron does.** "Iron is needed to make haemoglobin" earns the mark; describing tiredness alone doesn't.
- **Forgetting teeth for vitamin D and calcium.** They build strong bones **and teeth**.
- **Vague answers for fibre**, such as "keeps you healthy". Say it helps food move through the gut and prevents constipation.
- **Naming the gall bladder wrongly:** "bile", "bile duct" and "bladder" are all wrong. And the gall bladder **stores** bile; the liver **makes** it.
- **Mixing up the duodenum and the ileum**, or not knowing the parts of each intestine: small intestine = duodenum + ileum; large intestine = colon + rectum + anus.
- **Forgetting that the small intestine absorbs water too**, not just the colon.
- **Thinking physical digestion only happens in the mouth.** The stomach churns food as well.
- **Saying where digestion happens when asked what type it is.** "Chewing is physical digestion" answers the question; "it happens in the mouth" doesn't.
- **Mixing up canines and incisors**, or saying incisors grind. Incisors cut; molars and premolars grind.
- **Saying bile digests fat or is an enzyme.** Bile **emulsifies**; lipase digests.
- **Claiming every nutrient is "in the correct proportions"** when a table shows otherwise. Say what the data show.

How to get the marks

- **"State"** needs a word or short phrase, such as "gall bladder" or "vitamin C". Give one answer; a wrong extra one can cancel a right one.
- **"Describe the importance of"** a nutrient needs a specific job in the body ("to make haemoglobin"), and often the deficiency disease for a second mark.
- **Use the exact names:** oesophagus, duodenum, ileum, colon, rectum, gall bladder, dentine, cement. "Gullet", "food pipe" or "bowel" won't do.
- **Definitions of the five stages:** learn the key idea of each, since multiple-choice options often differ by one word ("into the blood" vs "into the cells").
- **Physical digestion** answers need both halves: smaller pieces **and** no chemical change. For "why", say it **increases the surface area for enzymes**.
- **Tooth functions:** pair each name with its function; mark schemes accept a range of verbs (cut, bite, tear, pierce, grip; chew, grind, crush).
- **Calculations:** write the values you used and the working, give units, and round only as the question asks. Working earns marks even if the final answer slips.
- **"Describe" data:** give the trend and a figure with its units. **"Explain":** give the reason.
- **Draw lines / circle / tick:** exactly as many as the question says; each extra one loses a mark.

Quick check

1. Name the vitamin that prevents scurvy, and give one good dietary source of it.
2. Put these in order: absorption, egestion, ingestion, assimilation, digestion.
3. Lentils contain 9.0 g of protein per 100 g. (a) Calculate the mass of protein in a 250 g portion. (b) A person needs 45 g of protein a day. How much more protein do they need after eating this portion?
4. A child needs 8 mg of iron a day. A supplement contains 2.5 mg of iron per tablet. Calculate the number of tablets needed to provide the child's daily iron, to 1 decimal place. State the disease a lack of iron causes.
5. (a) Name the two tooth types that grind food, and the two layers of a tooth under the enamel, from the outside in. (b) **Extended:** a 2 cm cube of food (surface area 24 cm²) is cut in half. Calculate the new total surface area and explain how bile has a similar effect on fats.

Answers

1. Vitamin C. Citrus fruit such as oranges (or other fresh fruit and vegetables).
2. Ingestion → digestion → absorption → assimilation → egestion.
3. (a) $9.0 \times \frac{250}{100} = 22.5$ g. (b) $45 - 22.5 = 22.5$ g.
4. $8 \div 2.5 = 3.2$ tablets. Anaemia.
5. (a) Premolars and molars; dentine, then pulp. (b) Two blocks, each $2 \text{ cm} \times 2 \text{ cm} \times 1 \text{ cm}$, each with surface area $2(2 \times 2 + 2 \times 1 + 2 \times 1) = 16 \text{ cm}^2$, so the total is 32 cm^2 . Bile emulsifies large fat drops into many small droplets, which in the same way increases the surface area for lipase to act on.

Past questions to try

- **0610/42/O/N/25 Q1**: physical digestion, organs on a diagram, bile and tooth functions (Extended).
- **0610/31/O/N/25 Q2**: a balanced diet and the importance of vitamins and minerals.
- **0610/33/O/N/25 Q6**: calculating protein from a yoghurt label, and the importance of fat and fibre.
- **0610/43/M/J/25 Q1**: completing a table of organs, letters and functions (Extended).