

HOLIDAY HOMEWORK 假期作业

IGCSE Biology

Exercise sheets and past-paper practice, topic by topic.

每个单元：练习卷 + 历年真题。

For class or self-study • no answer keys included.

Contents 目录

1	Characteristics of living things	3
2	Plant and animal cells	15
3	Diffusion and osmosis	23
4	Molecules of life	33
5	Enzymes and the lock and key	41
6	Photosynthesis	49
7	Diet and digestion	57
8	Xylem and phloem	73
9	The heart and circulation	83
10	Pathogens and defences	93
11	Gas exchange and the lungs	101
12	Respiration and energy	109

13	Excretion and the kidneys	119
14	The nervous system	127
15	Drugs and antibiotics	139
16	Reproduction and flowers.....	145
17	Chromosomes, genes and DNA	157
18	Variation and mutation	167
19	Food chains and energy	177
20	Food supply and deforestation.....	187
21	Biotechnology	199

1 Characteristics of living things – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
living organism	生物体	_____	_____	_____
life processes	生命过程	_____	_____	_____
characteristics	特征	_____	_____	_____
Movement	运动	_____	_____	_____
Respiration	呼吸作用	_____	_____	_____
energy	能量	_____	_____	_____
Sensitivity	应激性	_____	_____	_____
Growth	生长	_____	_____	_____
Reproduction	生殖	_____	_____	_____
Excretion	排泄	_____	_____	_____
waste	废物	_____	_____	_____
Nutrition	营养	_____	_____	_____
classify	分类	_____	_____	_____
species	物种	_____	_____	_____
fertile offspring	可育后代	_____	_____	_____

English	中文	Write it 3 times (English)
scientific name	学名	_____
binomial system	双名法	_____
genus	属	_____

Recall

A **living organism** 生物体 carries out **life processes** 生命过程—the activities that keep it alive. Every living thing, from a bacterium to a whale, does all seven of them.

Nothing here is hard; the trick is to learn the names and what each one means.

New ideas

Read these first, then do the Practice.

■ 1 The seven characteristics —MRS GREN

The seven **characteristics** 特征 of life spell **MRS GREN**:

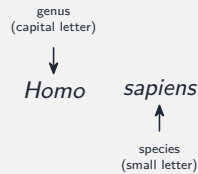
M	Movement
R	Respiration
S	Sensitivity
G	Growth
R	Reproduction
E	Excretion
N	Nutrition

- **Movement** 运动—changing position or place.
- **Respiration** 呼吸作用—releasing **energy** 能量 from food inside cells.
- **Sensitivity** 应激性—detecting and responding to changes.
- **Growth** 生长—a permanent increase in size.
- **Reproduction** 生殖—making more of the same kind of organism.
- **Excretion** 排泄—removing the **waste** 废物 made by the body's reactions.
- **Nutrition** 营养—taking in materials for energy and growth.

■ 2 Naming living things

Scientists **classify** 分类 living things—they sort them into groups by shared features. The smallest group is the **species** 物种 (organisms that can breed to make **fertile offspring** 可育后代).

Every species has a two-part **scientific name** 学名 (the **binomial system** 双名法), written in italics:



- the **genus** 属 comes first, with a capital letter;
- the species comes second, with a small letter.

Watch out: *excretion* (removing the body's *own* waste, like carbon dioxide or urea) is not the same as *egestion* (removing undigested food) —keep them apart. In a binomial name the genus has a capital and the species a small letter, both in italics.

Practice

Try these in order.

1.1 What seven words do the letters MRS GREN stand for? [4]

1.2 Define *excretion*. [2]

1.3 What is a *species*? [2]

1.4 Write the name *Homo sapiens* correctly, and say which part is the genus. [2]

1.5 Respiration is one of the seven characteristics. What does it release inside cells? [1]

1.6 Challenge. A car can move, "feed" on fuel and give off waste gases. Using two of the seven characteristics, explain why a car is still **not** a living organism. [2]

1 What is a characteristic of all living organisms?

- A breathing
- B photosynthesis
- C reproduction
- D transpiration

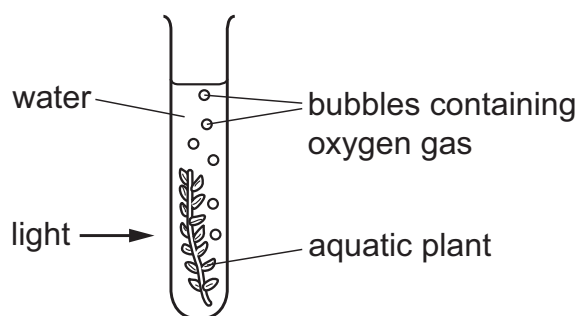
IGCSE Biology: s25 21

1 Which characteristic of living things requires carbon dioxide to diffuse into a leaf?

- A excretion
- B movement
- C nutrition
- D respiration

IGCSE Biology: s25 23

1 The diagram shows an aquatic plant in light.



What is a characteristic of **all** living things that is demonstrated in the diagram?

- A breathing
- B nutrition
- C photosynthesis
- D respiration

1 Classifying living things – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
kingdoms	界	_____	_____	_____
Animal	动物	_____	_____	_____
Plant	植物	_____	_____	_____
photosynthesis	光合作用	_____	_____	_____
Fungus	真菌	_____	_____	_____
mushrooms	蘑菇	_____	_____	_____
yeast	酵母	_____	_____	_____
Prokaryote	原核生物	_____	_____	_____
bacteria	细菌	_____	_____	_____
nucleus	细胞核	_____	_____	_____
Protoctist	原生生物	_____	_____	_____
algae	藻类	_____	_____	_____
Vertebrates	脊椎动物	_____	_____	_____
backbone	脊柱	_____	_____	_____
fish	鱼类	_____	_____	_____

English	中文	Write it 3 times (English)		
amphibians	两栖动物			
reptiles	爬行动物			
birds	鸟类			
mammals	哺乳动物			
Arthropods	节肢动物			
exoskeleton	外骨骼			
insects	昆虫			
arachnids	蛛形纲			
dichotomous key	二歧检索表			
Viruses	病毒			
protein coat	蛋白质外壳			
genetic material	遗传物质			
host	宿主			

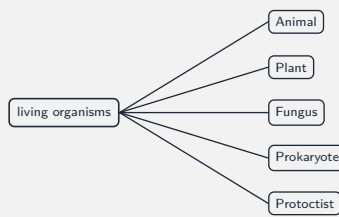
Recall

There are millions of kinds of living thing, so scientists sort them into groups. The biggest groups are the **kingdoms** 界. You decide where an organism belongs by looking at its features.

New ideas

Read these first, then do the Practice.

■ 1 The five kingdoms



Kingdom	A key feature
Animal 动物	many cells, no cell wall; feed on other organisms
Plant 植物	many cells with a cell wall; make food by photosynthesis 光合作用
Fungus 真菌	e.g. mushrooms 蘑菇 and yeast 酵母; feed on dead or living matter
Prokaryote 原核生物	e.g. bacteria 细菌; one cell, no nucleus 细胞核
Protocist 原生生物	e.g. algae 藻类; usually one cell, with a nucleus

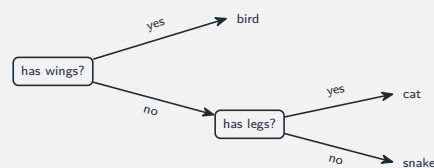
■ 2 Grouping the animals

Animals split into those with and without a backbone:

- **Vertebrates** 脊椎动物 have a **backbone** 脊柱—the five groups are **fish** 鱼类, **amphibians** 两栖动物, **reptiles** 爬行动物, **birds** 鸟类 and **mammals** 哺乳动物.
- **Arthropods** 节肢动物 have no backbone but a hard **exoskeleton** 外骨骼—e.g. **insects** 昆虫 and **arachnids** 蛛形纲.

■ 3 Dichotomous keys

A **dichotomous key** 二歧检索表 helps you name an unknown organism. At each step you choose between **two** options, and that choice sends you to the next step, until you reach a name.



■ 4 Viruses

Viruses 病毒 are not in any kingdom and are not made of cells. A virus is just a **protein coat** 蛋白质外壳 around its **genetic material** 遗传物质, and can only reproduce inside a living **host** 宿主.



Watch out: a **virus** is not in any kingdom—it is not made of cells and can only reproduce inside a host. In a dichotomous key, each step offers exactly **two** choices.

Practice

Try these in order.

1.6 Name the five kingdoms that living things are sorted into. [3]

1.7 What is the difference between a vertebrate and an arthropod? [2]

1.8 Give one feature of mammals and one feature of birds. [2]

1.9 What does "dichotomous" mean, and how many choices are there at each step? [2]

1.10 Why do some scientists say a virus is not a living organism? [1]

1.11 Challenge. An unknown animal has a backbone, feathers and lays hard-shelled eggs. State its vertebrate group, and give the feature that rules out "mammal". [2]

2 What can be used to classify organisms?

- A** the number of bases in DNA
- B** the number of different types of bases in DNA
- C** the sequence of bases in DNA
- D** the sequence of bases in one protein

IGCSE Biology: **w25 23**

2 What are the two parts of the scientific name of an organism?

- A** genus followed by kingdom
- B** genus followed by species
- C** kingdom followed by genus
- D** kingdom followed by species

IGCSE Biology: **s25 22**

4 What is a leaf?

- A** a cell
- B** an organ
- C** an organ system
- D** a tissue

2 Which set of features is characteristic only of birds?

- A** hair and wings
- B** hard-shelled eggs and feathers
- C** scales and soft-shelled eggs
- D** wings and soft-shelled eggs

3 A single-celled organism has chloroplasts, a cell wall and a nucleus.

Which kingdom is this organism placed in?

- A** fungus
- B** plant
- C** prokaryote
- D** protocist

2 Plant and animal cells – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
cells	细胞	_____	_____	_____
animal	动物	_____	_____	_____
plant	植物	_____	_____	_____
cell membrane	细胞膜	_____	_____	_____
cytoplasm	细胞质	_____	_____	_____
nucleus	细胞核	_____	_____	_____
genetic material	遗传物质	_____	_____	_____
mitochondria	线粒体	_____	_____	_____
respiration	呼吸作用	_____	_____	_____
ribosomes	核糖体	_____	_____	_____
proteins	蛋白质	_____	_____	_____
cell wall	细胞壁	_____	_____	_____
cellulose	纤维素	_____	_____	_____
vacuole	液泡	_____	_____	_____
cell sap	细胞液	_____	_____	_____

English	中文	Write it 3 times (English)
chloroplasts	叶绿体	_____
chlorophyll	叶绿素	_____
photosynthesis	光合作用	_____

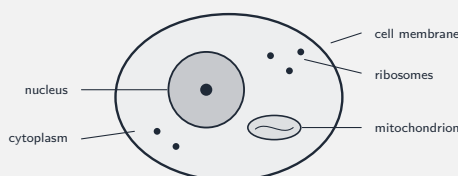
Recall

Every living thing is made of **cells** 细胞—the smallest parts that can carry out the life processes. Here you compare an **animal** 动物 cell with a **plant** 植物 cell.

New ideas

Read these first, then do the Practice.

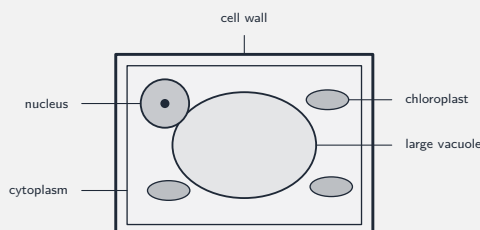
■ 1 The animal cell



- **cell membrane** 细胞膜—controls what enters and leaves the cell.
- **cytoplasm** 细胞质—jelly where many reactions happen.
- **nucleus** 细胞核—controls the cell; holds the **genetic material** 遗传物质.
- **mitochondria** 线粒体—where **respiration** 呼吸作用 releases energy.
- **ribosomes** 核糖体—where **proteins** 蛋白质 are made.

■ 2 The plant cell

A plant cell has everything an animal cell has, **plus** three extra parts:



- **cell wall** 细胞壁—made of **cellulose** 纤维素; gives strength and a fixed shape.
- a large **vacuole** 液泡—filled with **cell sap** 细胞液; keeps the cell firm.
- **chloroplasts** 叶绿体—hold **chlorophyll** 叶绿素 for **photosynthesis** 光合作用.

Watch out: a plant cell has **everything** an animal cell has **plus** a cell wall, a large vacuole and chloroplasts —so "has a nucleus" does not tell the two apart. Only those *extra three* are plant-only.

Practice

Try these in order.

2.1 Name three parts found in **both** a plant cell and an animal cell. [3]

2.2 Name the three parts found **only** in a plant cell. [3]

2.3 What is the job of the cell membrane? [1]

2.4 In which part of a cell does respiration take place? [1]

2.5 What substance is the plant cell wall made of? [1]

2.6 Challenge. A cell seen under a microscope has a nucleus, a cell wall and chloroplasts. Is it a plant or an animal cell? Give the feature that decides it. [2]

3 A palisade cell and a neurone are observed under a light microscope.

Which cell component is found only in the palisade cell?

- A** cell membrane
- B** cell wall
- C** cytoplasm
- D** nucleus

3 Which structures are found in both plant and animal cells?

- A** cell walls and cell membranes
- B** nuclei and cell walls
- C** cytoplasm and chloroplasts
- D** cell membranes and nuclei

3 Which structures are found in both plant cells and bacterial cells?

	cell membrane	cell wall	plasmid	ribosomes
A	yes	yes	yes	no
B	no	yes	yes	yes
C	yes	no	yes	yes
D	yes	yes	no	yes

2 Specialised cells and size – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
specialised cell	特化细胞	_____	_____	_____
red blood cell	红细胞	_____	_____	_____
oxygen	氧气	_____	_____	_____
root hair cell	根毛细胞	_____	_____	_____
nerve cell	神经元	_____	_____	_____
impulses	脉冲	_____	_____	_____
tissue	组织	_____	_____	_____
muscle	肌肉	_____	_____	_____
organ	器官	_____	_____	_____
organ system	器官系统	_____	_____	_____
digestive system	消化系统	_____	_____	_____
microscope	显微镜	_____	_____	_____
magnification	放大倍数	_____	_____	_____

Recall

Cells are the building blocks of life. Most cells are **specialised** —their shape suits one job —and they build up into larger structures.

New ideas

Read these first, then do the Practice.

■ 1 Specialised cells

A **specialised cell** 特化细胞 has a shape that suits its job:



red blood cell
(carries oxygen)



root hair cell
(absorbs water)



nerve cell
(carries impulses)

Cell	Job	How its shape helps
red blood cell 红细胞	carry oxygen 氧气	no nucleus, dish shape → holds more oxygen
root hair cell 根毛细胞	absorb water	long "hair" → large surface
nerve cell 神经元	carry impulses 脉冲	very long → reaches far

■ 2 Levels of organisation

Cells are organised into bigger and bigger structures:

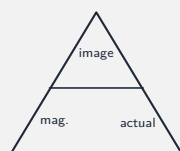


- a **tissue** 组织 is a group of similar cells (e.g. **muscle** 肌肉);
- an **organ** 器官 is several tissues working together (e.g. the heart);
- an **organ system** 器官系统 is several organs together (e.g. the **digestive system** 消化系统).

■ 3 Magnification

Cells are tiny, so we look at them with a **microscope** 显微镜. How much bigger the image is, is the **magnification** 放大倍数:

$$\text{magnification} = \frac{\text{image size}}{\text{actual size}}$$



Cover the quantity you want to find. Always use the **same unit** for both sizes (1 mm = 1000 μm).

Watch out: the levels of organisation go **cell** → **tissue** → **organ** → **organ system** → **organism**, in that order. For magnification use the *same unit* for both sizes, and $\text{magnification} = \text{image} \div \text{actual}$.

Practice

Try these in order.

2.6 Why does a red blood cell have no nucleus? [1]

2.7 Put these in order from smallest to largest: organ, cell, organism, tissue, organ system. [2]

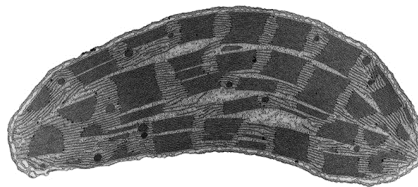
2.8 What is a *tissue*? [1]

2.9 A cell's image is 8 mm across at a magnification of $\times 400$. Work out its actual size in mm. [2]

2.10 How many micrometres (μm) are there in 1 mm? [1]

2.11 Challenge. A cell is actually 0.05 mm wide. Under a microscope its image is 20 mm wide. Calculate the magnification. [2]

- 4** The diagram shows an image of a chloroplast. The image is 5 cm long.



The actual length of the chloroplast is 5 μm .

What is the magnification of the image?

- A** $\times 10$ **B** $\times 1000$ **C** $\times 10\,000$ **D** $\times 100\,000$

- 4** In a human, the diameter of the aorta as it leaves the heart is 36 mm.

The thickness of the wall of the aorta at this point is 9 mm.

What is the diameter of the lumen of the aorta at this point?

- A** 1800 m **B** 2700 μm **C** 18 000 μm **D** 27 000 μm

- 4** A cell is 65 μm across.

What is this measurement in mm?

- A** 0.00065 mm **B** 0.0065 mm **C** 0.065 mm **D** 0.65 mm

3 Diffusion and osmosis – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
cell membrane	细胞膜	_____	_____	_____
Diffusion	扩散	_____	_____	_____
net movement	净移动	_____	_____	_____
higher concentra- tion	高浓度	_____	_____	_____
concentration gra- dient	浓度梯度	_____	_____	_____
oxygen	氧气	_____	_____	_____
carbon dioxide	二氧化碳	_____	_____	_____
surface area	表面积	_____	_____	_____
temperature	温度	_____	_____	_____
Osmosis	渗透	_____	_____	_____
partially perme- able membrane	半透膜	_____	_____	_____
solute	溶质	_____	_____	_____

Recall

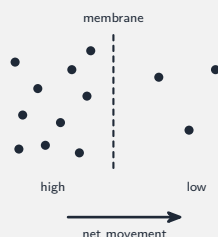
Substances move into and out of cells through the **cell membrane** 细胞膜, which controls what passes. Some movement needs no energy.

New ideas

Read these first, then do the Practice.

■ 1 Diffusion

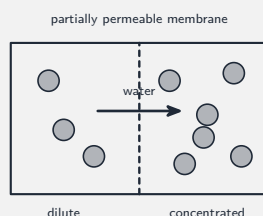
Diffusion 扩散 is the **net movement** 净移动 of particles from a **higher concentration** 高浓度 to a lower concentration —down the **concentration gradient** 浓度梯度. It needs **no** energy.



For example, **oxygen** 氧气 diffuses into cells and **carbon dioxide** 二氧化碳 diffuses out. Diffusion is faster with a larger **surface area** 表面积, a higher **temperature** 温度, a steeper gradient and a shorter distance.

■ 2 Osmosis

Osmosis 渗透 is a special kind of diffusion: the net movement of **water** across a **partially permeable membrane** 半透膜 (it lets small water molecules through but holds back larger **solute** 溶质 particles).



Water moves from a **dilute** solution (lots of water) to a **concentrated** solution (little water).

Watch out: **osmosis** moves *water only*, across a partially permeable membrane; **diffusion** moves any particle down its gradient. Water moves *to* the more **concentrated** solution (the side with less water).

Practice

Try these in order.

3.1 Define *diffusion*.

[2]

3.2 Does diffusion need energy from respiration? [1]

3.3 Name two things that make diffusion faster. [2]

3.4 What is *osmosis*? [2]

3.5 In osmosis, does water move to the dilute or the concentrated solution? [1]

3.6 Challenge. A piece of potato is left in pure water and gains mass. Explain why, using osmosis. [2]

- 5** Diffusion may be defined as the net movement of particles from a region of their1..... concentration, to a region of their2..... concentration, where movement is3..... a concentration gradient.

Which words complete gaps 1, 2 and 3?

	1	2	3
A	higher	lower	down
B	higher	lower	up
C	lower	higher	down
D	lower	higher	up

3 Active transport and plant cells – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
Active transport	主动运输	_____
energy	能量	_____
respiration	呼吸作用	_____
carrier protein	载体蛋白	_____
root hairs	根毛	_____
turgid	膨胀	_____
flaccid	松软	_____
plasmolysis	质壁分离	_____

Recall

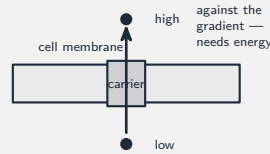
Diffusion and osmosis move particles **down** a gradient and need no energy. But cells sometimes need to move substances the other way.

New ideas

Read these first, then do the Practice.

■

Active transport 主动运输 moves particles through the cell membrane from a **lower** to a **higher** concentration —**against** the gradient. Because it is "uphill", it needs **energy** 能量 from **respiration** 呼吸作用, and a **carrier protein** 载体蛋白.



For example, **root hairs** 根毛 take up mineral ions from the soil this way.

■ **2 Osmosis and plant cells**

Water entering or leaving a plant cell changes how firm it is:



- in water, cells take in water and become **turgid** 膨胀 (firm) —this supports the plant;
- in a concentrated solution, cells lose water and become **flaccid** 松软 (soft);
- if much more water leaves, the membrane pulls away from the wall —**plasmolysis** 质壁分离.

■ **3 Comparing the three**

Process	Direction	Needs energy?
diffusion	high → low	no
osmosis	water, dilute → concentrated	no
active transport	low → high (against)	yes

Watch out: **active transport** moves particles *against* the gradient (low → high) and **needs energy** from respiration —diffusion and osmosis are passive and need none. A cell in pure water becomes **turgid** (firm), not flaccid.

Practice

Try these in order.

3.6 How is active transport different from diffusion? [2]

3.7 Where does the energy for active transport come from? [1]

3.8 Give one example of active transport in a plant. [1]

3.9 A plant cell is put in pure water. Will it become turgid or flaccid? [1]

3.10 Which of the three processes moves **water only**? [1]

3.11 Challenge. Root cells take in mineral ions even when the soil has a *lower* ion concentration than the cells. Name the process they use, and explain why it needs energy. [3]

- 7** Uncooked potato cylinders of identical size were placed in four different liquids for two hours.

The different liquids are listed.

- 1 pure water
- 2 a sugar solution that was less concentrated than the contents of the potato cells
- 3 a sugar solution that was more concentrated than the contents of the potato cells
- 4 a sugar solution that was the same concentration as the contents of the potato cells

In which liquids will the potato cylinders increase in length?

- A** 1 and 2 **B** 1 and 3 **C** 2 and 4 **D** 3 and 4

- 3** What happens when plant cells are placed in a sugar solution that has a lower water potential than the cytoplasm of the cells?

- A** The cells gain water and become flaccid.
B The cells gain water and become turgid.
C The cells lose water and become flaccid.
D The cells lose water and become turgid.

- 7** A potato was removed from a potato plant. A 5 g cube of potato was cut and put into a beaker of distilled water.

What is the most likely mass of the cube of potato after two hours?

- A** 2 g **B** 4 g **C** 5 g **D** 7 g

18 Which process requires energy from respiration?

- A** diffusion
- B** osmosis
- C** protein synthesis
- D** transpiration

IGCSE Biology: **s25 23**

19 Which process in plants uses energy from respiration?

- A** cell division
- B** osmosis
- C** photosynthesis
- D** transpiration

IGCSE Biology: **m25 22**

6 Three processes are listed.

- 1 Molecules or ions are moved across membranes.
- 2 Molecules or ions are moved by protein carriers.
- 3 Ions are taken up by root hairs.

Which processes can involve active transport?

- A** 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

4 Molecules of life – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
molecule	分子	_____	_____	_____
carbohydrates	碳水化合物	_____	_____	_____
fats	脂肪	_____	_____	_____
proteins	蛋白质	_____	_____	_____
elements	元素	_____	_____	_____
carbon	碳	_____	_____	_____
hydrogen	氢	_____	_____	_____
nitrogen	氮	_____	_____	_____
starch	淀粉	_____	_____	_____
cellulose	纤维素	_____	_____	_____
glucose	葡萄糖	_____	_____	_____
amino acids	氨基酸	_____	_____	_____
fatty acids	脂肪酸	_____	_____	_____
glycerol	甘油	_____	_____	_____

Recall

Living things are built from three main kinds of **molecule** 分子: **carbohydrates** 碳水化合物, **fats** 脂肪 and **proteins** 蛋白质. Each is made from a few chemical **elements** 元素.

New ideas

Read these first, then do the Practice.

■ 1 The elements in food

carbohydrates
and fats
C H O

proteins
C H O N

- carbohydrates and fats: **carbon** 碳, **hydrogen** 氢 and oxygen.
- proteins: the same three, plus **nitrogen** 氮.

■ 2 Big molecules from small units

Large molecules are built by joining many small units, like beads on a string:



many glucose → starch



amino acids → protein



glycerol + fatty acids → fat

Large molecule	Built from
starch 淀粉 (and cellulose 纤维素)	many glucose 葡萄糖 units
proteins	amino acids 氨基酸
fats	fatty acids 脂肪酸 and glycerol 甘油

Watch out: carbohydrates and fats contain carbon, hydrogen and oxygen; **proteins** contain those three **plus nitrogen** —nitrogen is the giveaway for protein. Starch is made of **glucose**, but a fat is made of *two* kinds of unit (fatty acids **and** glycerol).

Practice

Try these in order.

4.1 Which three elements are found in carbohydrates? [1]

4.2 Which extra element do proteins contain? [1]

4.3 What small units join together to make starch? [1]

4.4 What two kinds of molecule join together to make a fat? [2]

4.5 Name the small units that make up a protein. [1]

4.6 Challenge. A food molecule contains nitrogen as well as carbon, hydrogen and oxygen. What type of molecule is it, and what small units is it built from? [2]

4 Food tests and DNA – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
starch	淀粉	_____	_____	_____
iodine solution	碘液	_____	_____	_____
reducing sugar	还原糖	_____	_____	_____
Benedict's solution	本尼迪特试剂	_____	_____	_____
protein	蛋白质	_____	_____	_____
biuret	双缩脲	_____	_____	_____
fat	脂肪	_____	_____	_____
ethanol	乙醇	_____	_____	_____
genetic material	遗传物质	_____	_____	_____
double helix	双螺旋	_____	_____	_____
strands	链	_____	_____	_____
bases	碱基	_____	_____	_____

Recall

You can find out which substances a food contains by adding a test chemical and watching for a colour change.

New ideas

Read these first, then do the Practice.

■ 1 Food tests

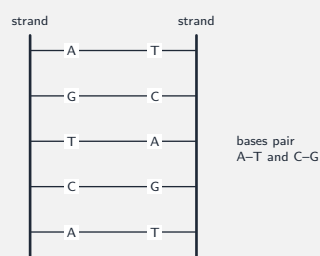
test for	start	positive
starch	orange-brown	→ blue-black
reducing sugar	blue	→ brick-red
protein	blue	→ purple
fat	clear	→ cloudy white

Food	Test	Positive result
starch 淀粉	iodine solution 碘液	orange-brown → blue-black
reducing sugar 还原糖	Benedict's solution 本尼迪特试剂 + heat	blue → brick-red
protein 蛋白质	biuret 双缩脲 solution	blue → purple
fat 脂肪	ethanol 乙醇 emulsion	a cloudy white layer

Only the Benedict's test needs **heating**.

■ 2 The structure of DNA

DNA carries the **genetic material** 遗传物质—the instructions for the organism. It is a **double helix** 双螺旋 (a twisted ladder) of two **strands** 链, joined by pairs of **bases** 碱基:



The bases always pair **A with T** and **C with G**, so one strand tells you the other.

Watch out: only the **Benedict's** test (for reducing sugar) needs *heating*; the others are done cold. In DNA the bases pair **A–T** and **C–G** *always*, so one strand gives you the other.

Practice

Try these in order.

4.6 Which test, and which colour change, shows that a food contains starch? [2]

4.7 Which food test needs heating? [1]

4.8 A food turns biuret solution purple. What does the food contain? [1]

4.9 DNA is called a "double helix". What shape is that? [1]

4.10 In DNA, base A pairs with which base, and C pairs with which? [2]

4.11 Challenge. One strand of DNA reads **A C G T**. Write the bases on the matching strand. [2]

5 A DNA molecule contains pairs of bases.

What is a correct combination of a pair of bases?

- A** A and G **B** C and A **C** G and T **D** T and A

6 What is the test for protein?

	name of the test	heat	colour change
A	Benedict's	yes	blue to purple
B	biuret	yes	blue to red
C	biuret	no	blue to purple
D	Benedict's	no	blue to red

21 What is the chemical formula of glucose?

- A** $C_6H_6O_6$ **B** C_6HO_6 **C** $C_6H_{12}O_6$ **D** $C_{12}H_{12}O_6$

7 A section of a chromosome contains 4500 bases. There are 1450 G bases.

How many A bases are there?

- A** 800 **B** 1450 **C** 1600 **D** 2900

8 Which chemical element is found in proteins but **not** in carbohydrates?

- A** carbon
B hydrogen
C nitrogen
D oxygen

5 Enzymes and the lock and key – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
catalyst	催化剂	_____
chemical reaction	化学反应	_____
Enzymes	酶	_____
proteins	蛋白质	_____
metabolism	新陈代谢	_____
active site	活性位点	_____
substrate	底物	_____
products	产物	_____
complementary	互补	_____
specific	专一	_____

Recall

A **catalyst** 催化剂 speeds up a **chemical reaction** 化学反应 but is **not** used up, so it can be used again and again.

New ideas

Read these first, then do the Practice.

■ 1 What enzymes are

Enzymes 酶 are biological catalysts —catalysts made by living cells. They are **proteins** 蛋白质, and they control almost every reaction of **metabolism** 新陈代谢. Without them, life's reactions would be far too slow.

■ 2 The lock and key

Each enzyme has a pocket called the **active site** 活性位点. The molecule it works on, the **substrate** 底物, fits the active site like a key in a lock:



The substrate slots in, the reaction happens, and the **products** 产物 leave. The enzyme is then free to be used again.

■ 3 Enzymes are specific

The active site has a shape **complementary** 互补 to the substrate, so each enzyme is **specific** 专一—it works on only one substrate. The wrong substrate does not fit:



Watch out: an enzyme is **specific** because the substrate must fit its **active site** like a key in a lock —the wrong substrate does not fit. The enzyme is **not used up**, so a little enzyme can convert a lot of substrate.

Practice

Try these in order.

5.1 What is a *catalyst*?

[2]

5.2 Enzymes are made of which type of molecule?

[1]

5.3 What name is given to the pocket where the substrate fits? [1]

5.4 What does it mean to say an enzyme is "specific"? [1]

5.5 After the reaction, what happens to the enzyme? [1]

5.6 Challenge. An enzyme that breaks down starch has no effect on protein. Explain why, using the lock-and-key idea. [2]

5 Temperature and pH – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
temperature	温度	_____
kinetic energy	动能	_____
optimum temperature	最适温度	_____
denatured	变性	_____
optimum pH	最适	_____

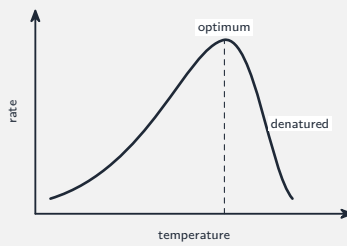
Recall

Each enzyme works best in certain conditions. Two conditions matter most: **temperature** 温度 and **pH**.

New ideas

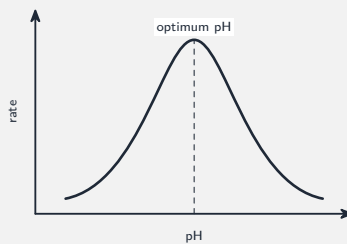
Read these first, then do the Practice.

■ 1 Temperature



- As it warms up, the reaction speeds up —molecules have more **kinetic energy** 动能 and meet more often.
- The rate is highest at the **optimum temperature** 最适温度 (about 37 °C in humans).
- If it gets too hot, the active site changes shape and the substrate no longer fits — the enzyme is **denatured** 变性. This is permanent.

■ 2 pH



Each enzyme has one **optimum pH** 最适 pH. If the pH is too high or too low, the active site changes shape and the enzyme is denatured.

Note: "denatured" does **not** mean "killed" —enzymes are not alive. It means the active site has lost its shape, so the substrate no longer fits.

Watch out: above the **optimum**, heat **denatures** the enzyme —the active site loses its shape and the substrate no longer fits. Denaturing is **permanent** and does **not** mean "killed" (enzymes are not alive).

Practice

Try these in order.

5.6 At about what temperature do human enzymes work best?

[1]

5.7 Why does enzyme activity increase as the temperature rises (before the optimum)?[1]

5.8 What does "denatured" mean? [2]

5.9 Is denaturing an enzyme by heat reversible? [1]

5.10 Name two conditions that can denature an enzyme. [2]

5.11 Challenge. An enzyme works fastest at 40 °C. Predict and explain what happens to its rate at (a) 10 °C and (b) 70 °C. [3]

6 Which substance is an enzyme?

- A** fibrinogen
- B** mRNA
- C** pepsin
- D** saliva

IGCSE Biology: **s25 22**

8 What is the correct definition of enzymes?

- A** carbohydrates that act as biological catalysts
- B** carbohydrates that act as substrates
- C** proteins that act as biological catalysts
- D** proteins that act as substrates

IGCSE Biology: **m25 22**

9 Which statement describes enzymes?

- A** Enzymes are carbohydrates.
- B** Enzymes are involved in metabolic reactions.
- C** Enzymes decrease the rate of reaction.
- D** Enzymes have the same shape of active site as their substrate.

6 Photosynthesis – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
Photosynthesis	光合作用	_____	_____	_____
energy	能量	_____	_____	_____
chlorophyll	叶绿素	_____	_____	_____
pigment	色素	_____	_____	_____
chloroplasts	叶绿体	_____	_____	_____
starch	淀粉	_____	_____	_____
cellulose	纤维素	_____	_____	_____
respiration	呼吸作用	_____	_____	_____
sucrose	蔗糖	_____	_____	_____
ions	离子	_____	_____	_____
nitrate	硝酸盐	_____	_____	_____
amino acids	氨基酸	_____	_____	_____
magnesium	镁	_____	_____	_____

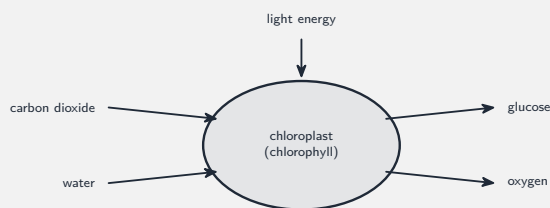
Recall

Plants make their own food. **Photosynthesis** 光合作用 is how they do it, using **energy** 能量 from light.

New ideas

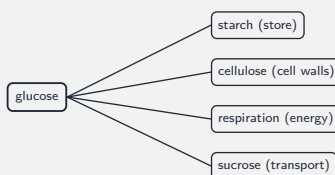
Read these first, then do the Practice.

■ 1 The word equation



The reaction happens only in the light, and only where there is **chlorophyll** 叶绿素—a green **pigment** 色素 in the **chloroplasts** 叶绿体.

■ 2 What the plant does with the glucose



- stored as **starch** 淀粉;
- built into **cellulose** 纤维素 for cell walls;
- broken down in **respiration** 呼吸作用 for energy;
- changed to **sucrose** 蔗糖 and moved around the plant.

■ 3 Minerals from the soil

Plants also take up mineral **ions** 离子 through their roots:

- **nitrate** 硝酸盐 ions → to make **amino acids** 氨基酸 (and proteins);
- **magnesium** 镁 ions → to make chlorophyll.

Watch out: photosynthesis needs **light and chlorophyll**—in the dark, or in a white (non-green) part of a leaf, it cannot happen. The glucose made is used for starch, cellulose, respiration and (as sucrose) transport.

Practice

Try these in order.

6.1 Write the word equation for photosynthesis. [2]

6.2 What two things must be present for photosynthesis to happen? [2]

6.3 Name the green pigment that traps light. [1]

6.4 Give two things a plant does with the glucose it makes. [2]

6.5 Why does a plant need nitrate ions? [1]

6.6 Challenge. A green plant is kept in the dark for two days. Explain why it cannot photosynthesise, and what happens to its store of starch. [2]

8 Which substance contains magnesium ions?

- A** cellulose
- B** chlorophyll
- C** glucose
- D** glycerol

6 What is the balanced chemical equation for photosynthesis?

- A** $3\text{CO}_2 + 3\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 3\text{O}_2$
- B** $6\text{CO}_2 + 6\text{O}_2 \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{H}_2\text{O}$
- C** $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$
- D** $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow 6\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$

6 Rate and leaf structure – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
rate	速率	_____	_____	_____
light intensity	光照强度	_____	_____	_____
temperature	温度	_____	_____	_____
limiting factor	限制因素	_____	_____	_____
adapted	适应	_____	_____	_____
palisade	栅栏	_____	_____	_____
chloroplasts	叶绿体	_____	_____	_____
spongy	海绵	_____	_____	_____
air spaces	气腔	_____	_____	_____
stomata	气孔	_____	_____	_____
guard cells	保卫细胞	_____	_____	_____

Recall

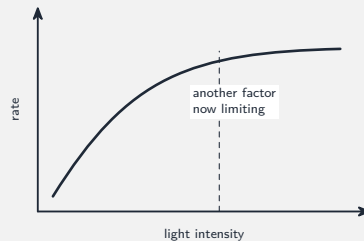
Photosynthesis goes faster or slower depending on the conditions, and the leaf is well built for the job.

New ideas

Read these first, then do the Practice.

■ 1 Rate and limiting factors

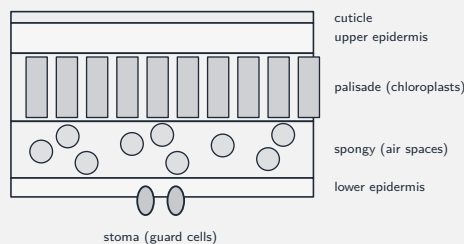
Three things change the **rate** 速率 of photosynthesis: **light intensity** 光照强度, carbon dioxide level and **temperature** 温度.



At any moment, the factor in shortest supply holds back the rate —the **limiting factor** 限制因素. More light speeds things up until carbon dioxide or temperature becomes limiting.

■ 2 Leaf structure

A leaf is **adapted** 适应 for photosynthesis —broad and thin, to catch light and let gases reach every cell:



- the **palisade** 栅栏 cells near the top are packed with **chloroplasts** 叶绿体;
- the **spongy** 海绵 layer has **air spaces** 气腔 so gases move easily;
- tiny holes called **stomata** 气孔 (opened by **guard cells** 保卫细胞) let carbon dioxide in and oxygen out.

Watch out: on a rate–light graph the line **levels off** when something *else* (carbon dioxide or temperature) becomes the **limiting factor** —adding more light then does nothing. A leaf is broad and thin to catch light and let gases reach every cell.

Practice

Try these in order.

6.6 Name three factors that affect the rate of photosynthesis.

[3]

6.7 What is a *limiting factor*? [1]

6.8 Which cells in the leaf do most of the photosynthesis, and why? [2]

6.9 What is the job of the stomata? [1]

6.10 Why is a leaf broad and thin? [2]

6.11 Challenge. On a bright, warm day a greenhouse grower wants faster photosynthesis. Suggest one thing they could add to the air, and explain why it helps. [2]

- 9** A student wrote some statements about the palisade mesophyll and spongy mesophyll tissues.
- 1 The spongy mesophyll tissue is near the stomata for gas exchange.
 - 2 Only palisade mesophyll cells have chloroplasts for photosynthesis.
 - 3 Palisade cells are closely packed but there are air spaces in the spongy mesophyll tissue.

Which statements are correct descriptions of the two tissues?

- A** 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

- 8** Which descriptions of adaptations for photosynthesis are correct for spongy mesophyll tissue?

	air spaces for efficient gas exchange	long, rectangular cells to absorb light
A	yes	yes
B	yes	no
C	no	yes
D	no	no

7 Diet and digestion – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
balanced diet	均衡饮食	_____	_____	_____
digestive system	消化系统	_____	_____	_____
carbohydrates	碳水化合物	_____	_____	_____
energy	能量	_____	_____	_____
fats	脂肪	_____	_____	_____
proteins	蛋白质	_____	_____	_____
vitamins	维生素	_____	_____	_____
mineral ions	矿物质离子	_____	_____	_____
fibre	膳食纤维	_____	_____	_____
scurvy	坏血病	_____	_____	_____
iron	铁	_____	_____	_____
alimentary canal	消化道	_____	_____	_____
Physical digestion	物理消化	_____	_____	_____
surface area	表面积	_____	_____	_____
teeth	牙齿	_____	_____	_____

English	中文	Write it 3 times (English)		
incisors	门齿			
canines	犬齿			
premolars	前臼齿			
molars	臼齿			

Recall

A **balanced diet** 均衡饮食 gives the body everything it needs. The food is then broken down by the **digestive system** 消化系统.

New ideas

Read these first, then do the Practice.

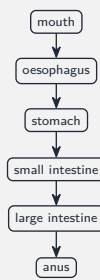
■ 1 A balanced diet

Part of diet	Why you need it
carbohydrates 碳水化合物	the main source of energy 能量
fats 脂肪	an energy store; keep you warm
proteins 蛋白质	growth and repair of cells
vitamins 维生素 and mineral ions 矿物质离子	small amounts keep the body healthy
fibre 膳食纤维	keeps food moving through the gut
water	needed for all reactions

Too little vitamin C → **scurvy** 坏血病; too little **iron** 铁 → too few red blood cells.

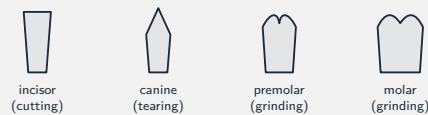
■ 2 The gut

Food passes along one long tube, the **alimentary canal** 消化道:



■ 3 Teeth and physical digestion

Physical digestion 物理消化 breaks food into smaller pieces —a larger **surface area** 表面积 for the enzymes —without changing the molecules. Your **teeth** 牙齿 do this:



incisors 门齿 cut, **canines** 犬齿 tear, and **premolars** 前臼齿 and **molars** 臼齿 grind.

Watch out: each food group has its own job —proteins for **growth and repair**, carbohydrates for **energy**, fats for an energy **store** —don't muddle them. *Physical* digestion (teeth) breaks food into pieces; *chemical* digestion (enzymes) breaks the molecules.

Practice

Try these in order.

7.1 Which part of the diet is the main source of energy? [1]

7.2 What is fibre for? [1]

7.3 Too little vitamin C causes which disease? [1]

7.4 List, in order, the parts food passes through from the stomach to the anus. [2]

7.5 What is the job of the incisor teeth?

[1]

7.6 Challenge. A person eats almost no fresh fruit or vegetables. Name the deficiency disease they may get, and the vitamin that is missing.

[2]

10 Which term is used for the uptake and use of nutrients by cells?

- A** absorption
- B** assimilation
- C** egestion
- D** ingestion

11 What is the function of trypsin in digestion?

- A** It catalyses the breakdown of maltose in the mouth.
- B** It catalyses the breakdown of maltose in the small intestine.
- C** It catalyses the breakdown of protein in the small intestine.
- D** It catalyses the breakdown of protein in the stomach.

10 A person has swollen, bleeding gums and slow wound healing.

This could be caused by a lack of which nutrient in a diet?

- A** calcium
- B** fibre
- C** iron
- D** vitamin C

1 (a) Fig. 1.1 is a diagram of the human digestive system.

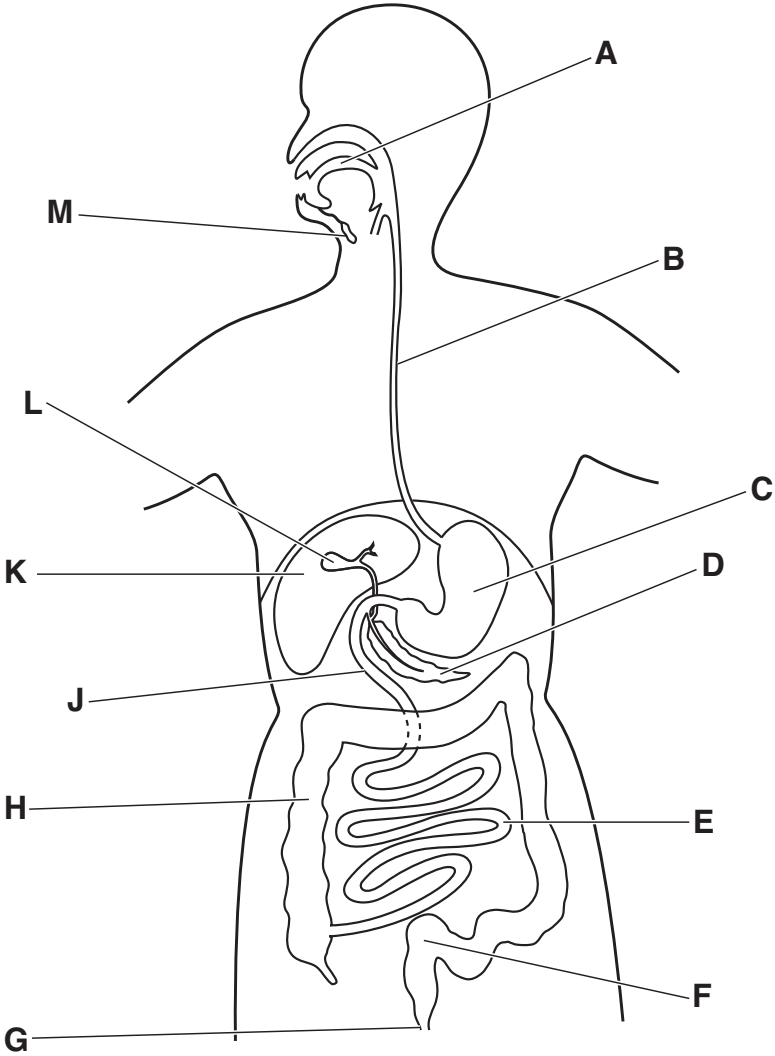


Fig. 1.1

Table 1.1 shows information about some of the structures shown in Fig. 1.1.

Complete Table 1.1, using Fig. 1.1.

Table 1.1

name of the structure	function	letter in Fig. 1.1
		G
	produces amylase	
gall bladder		
	transports food to the stomach	

(b) (i) Describe the role of chemical digestion.

[3]

(ii) Maltose is digested by maltase.

State the name of the product of this reaction.

[1]

(iii) Describe where maltose is digested in the small intestine.

[1]

(iv) Explain why amylase digests starch in the small intestine but does **not** digest starch in the stomach.

[6]

[Total: 15]

7 Enzymes and absorption – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
Chemical digestion	化学消化	_____	_____	_____
enzymes	酶	_____	_____	_____
soluble	可溶	_____	_____	_____
amylase	淀粉酶	_____	_____	_____
starch	淀粉	_____	_____	_____
sugars	糖	_____	_____	_____
protease	蛋白酶	_____	_____	_____
protein	蛋白质	_____	_____	_____
amino acids	氨基酸	_____	_____	_____
lipase	脂肪酶	_____	_____	_____
fatty acids	脂肪酸	_____	_____	_____
glycerol	甘油	_____	_____	_____
hydrochloric acid	盐酸	_____	_____	_____
microorganisms	微生物	_____	_____	_____
villi	绒毛	_____	_____	_____

English	中文	Write it 3 times (English)
surface area	表面积	_____
absorption	吸收	_____
capillary	毛细血管	_____
lacteal	乳糜管	_____

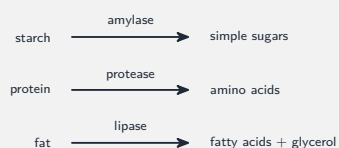
Recall

Large food molecules are too big to enter the blood. **Chemical digestion** 化学消化 uses **enzymes** 酶 to break them into small, **soluble** 可溶 molecules.

New ideas

Read these first, then do the Practice.

■ 1 The digestive enzymes

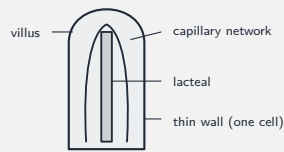


Enzyme	Breaks down	Into
amylase 淀粉酶	starch 淀粉	simple sugars 糖
protease 蛋白酶	protein 蛋白质	amino acids 氨基酸
lipase 脂肪酶	fats	fatty acids 脂肪酸 and glycerol 甘油

The stomach also makes **hydrochloric acid** 盐酸, which kills **microorganisms** 微生物 and gives the best pH for its protease.

■ 2 Absorption in the villi

The small intestine is lined with millions of tiny finger-shaped **villi** 绒毛 that give a huge **surface area** 表面积 for **absorption** 吸收:



Each villus has a thin wall (a short distance to travel), a **capillary** 毛细血管 network (takes up sugars and amino acids) and a **lacteal** 乳糜管 (takes up fats).

Watch out: match each enzyme to its food —**amylase** → starch, **protease** → protein, **lipase** → fats. The **villi** are adapted for fast absorption: a huge surface area, thin walls and a rich blood supply.

Practice

Try these in order.

7.6 Which enzyme breaks down starch, and what does it make? [2]

7.7 Protease breaks protein down into what? [1]

7.8 Give two jobs of the acid in the stomach. [2]

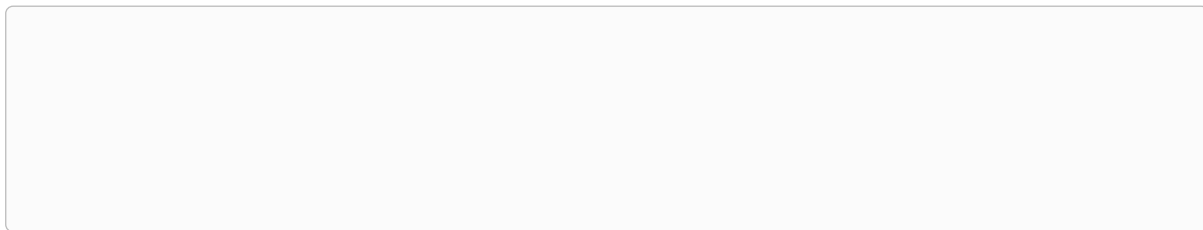
7.9 Why is the small intestine lined with villi? [1]

7.10 Name the two transport vessels found inside a villus. [2]

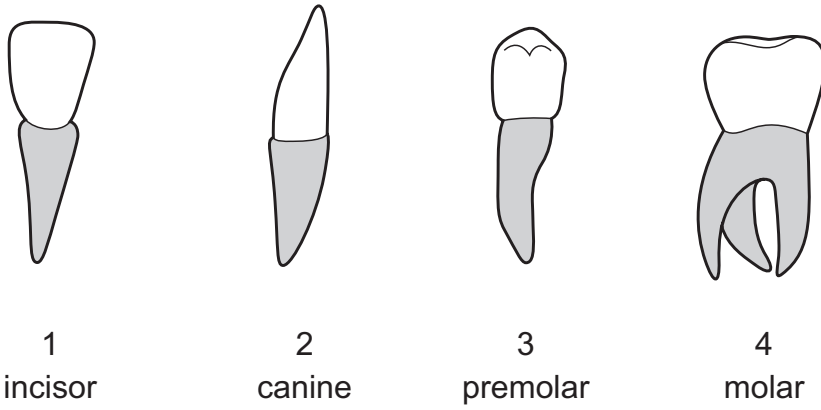
7.11 Challenge. Explain how **two** features of a villus help it absorb digested food

quickly.

[2]



13 The diagram shows the four types of human tooth.



Which teeth are used for grinding food?

- A** 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

10 What is a role of bile?

- A** It contains enzymes that digest starch.
- B** It emulsifies fats, increasing their surface area.
- C** It kills bacteria in food.
- D** It provides the optimum pH for pepsin activity.

IGCSE Biology: w25 22

7 Which function is performed in the duodenum?

- A** assimilation
- B** digestion
- C** egestion
- D** ingestion

IGCSE Biology: w25 23

11 What is an example of chemical digestion?

- A** breaking down starch into reducing sugars
- B** churning of food by muscular contractions of the stomach wall
- C** grinding of food by teeth
- D** mixing of food with bile

IGCSE Biology: m25 22

14 Which substance causes the change in pH when food enters the small intestine?

- A** amylase
- B** bile
- C** gastric juice
- D** trypsin

13 What is the function of microvilli in the small intestine?

- A** conduction of electrical impulses
- B** increasing surface area for absorption
- C** movement of food particles
- D** movement of mucus

11 Digested food molecules move into the cells of the body where they are used and become part of the cells.

What is this a definition of?

- A** absorption
- B** assimilation
- C** digestion
- D** ingestion

8 Xylem and phloem – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
transport tissues	运输组织	_____	_____	_____
xylem	木质部	_____	_____	_____
phloem	韧皮部	_____	_____	_____
mineral ions	矿物质离子	_____	_____	_____
lignin	木质素	_____	_____	_____
sucrose	蔗糖	_____	_____	_____
amino acids	氨基酸	_____	_____	_____
vascular bundles	维管束	_____	_____	_____
root hair cells	根毛细胞	_____	_____	_____
surface area	表面积	_____	_____	_____

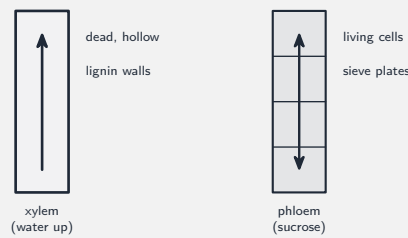
Recall

Plants have two **transport tissues** 运输组织 running through the roots, stem and leaves: **xylem** 木质部 and **phloem** 韧皮部.

New ideas

Read these first, then do the Practice.

■ 1 Xylem and phloem

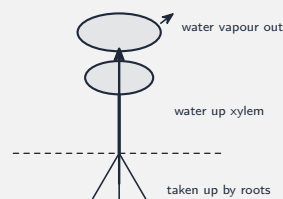


- **xylem** carries water and **mineral ions** 矿物质离子 **up** from the roots, and supports the plant. Its cells are dead, hollow tubes with walls strengthened by **lignin** 木质素.
- **phloem** carries **sucrose** 蔗糖 and **amino acids** 氨基酸 to wherever they are needed. Its cells are living.

They lie side by side in **vascular bundles** 维管束.

■ 2 Water uptake

Water enters through **root hair cells** 根毛细胞. Their huge number gives a large **surface area** 表面积 for fast uptake. The water then travels up:



root hairs → xylem → leaves.

Watch out: **xylem** carries water and minerals **up** only, in *dead* hollow tubes; **phloem** carries sucrose and amino acids *both* ways, in *living* cells —keep the two apart. Root hair cells speed uptake by giving a large surface area.

Practice

Try these in order.

8.1 What does xylem carry, and in which direction? [2]

8.2 What does phloem carry? [1]

8.3 Why are xylem walls strengthened with lignin? [1]

8.4 Through which cells does water enter a plant? [1]

8.5 Why do root hairs help the plant take up water quickly? [1]

8.6 Challenge. Give **two** ways the structure of a xylem vessel suits its job of carrying water up the plant. [2]

12 What is a structural feature of xylem vessels?

- A** contain many mitochondria
- B** made up of cells joined end to end
- C** presence of cross walls
- D** thin walls

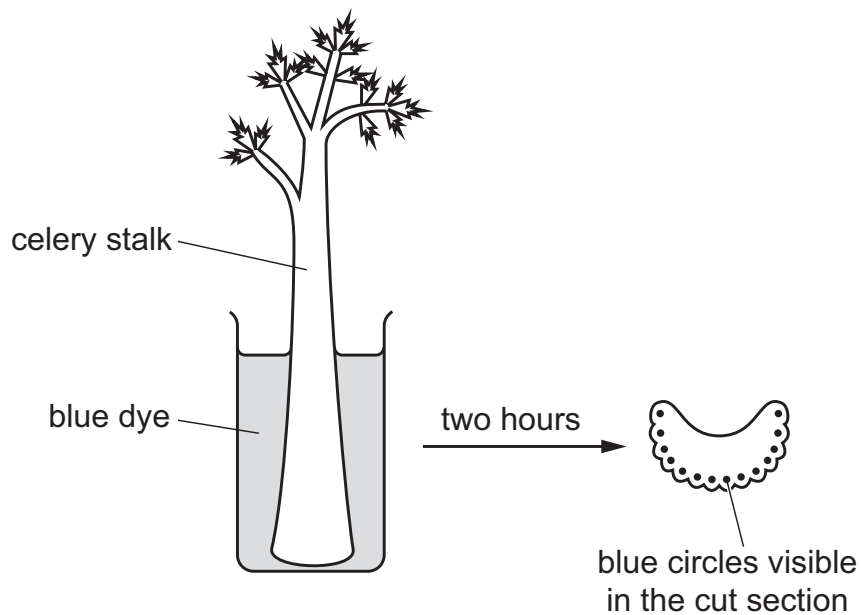
14 Which row shows the features of xylem vessels?

	vessel walls	mitochondria present
A	thick	yes
B	thick	no
C	thin	yes
D	thin	no

10 A student cut one stalk of celery from a celery plant.

They put the celery stalk into a beaker of blue dye.

The celery stalk was removed from the blue dye after two hours and was cut into sections.



What is shown by the blue circles in the cut sections of celery stalk?

- A** position of the cortex cells
- B** position of the palisade cells
- C** position of the phloem cells
- D** position of the xylem vessels

8 Transpiration and translocation – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
Transpiration	蒸腾作用	_____	_____	_____
water vapour	水蒸气	_____	_____	_____
evaporates	蒸发	_____	_____	_____
mesophyll	叶肉	_____	_____	_____
diffuses	扩散	_____	_____	_____
stomata	气孔	_____	_____	_____
transpiration pull	蒸腾拉力	_____	_____	_____
Translocation	转运	_____	_____	_____
source	源	_____	_____	_____
sink	库	_____	_____	_____

Recall

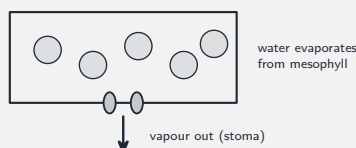
Most of the water a plant takes up is lost again from its leaves. This loss is called transpiration.

New ideas

Read these first, then do the Practice.

■ 1 Transpiration

Transpiration 蒸腾作用 is the loss of **water vapour** 水蒸气 from the leaves:

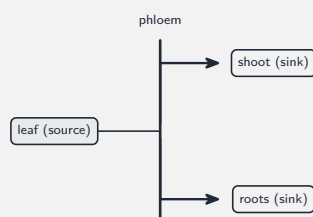


- water **evaporates** 蒸发 from the wet **mesophyll** 叶肉 cells into the air spaces;
- the vapour then **diffuses** 扩散 out through the **stomata** 气孔.

It is faster when it is hotter, windier or drier. The loss pulls more water up the xylem—the **transpiration pull** 蒸腾拉力.

■ 2 Translocation

Translocation 转运 is the movement of sucrose in the phloem, from a **source** 源 (where it is made, e.g. a leaf) to a **sink** 库 (where it is used or stored, e.g. roots):



The direction can change with the season.

Watch out: transpiration (water vapour leaving the leaf) is faster when it is hotter, windier or drier. **Translocation** moves sucrose in the *phloem* from **source** to **sink**, and the direction can change with the season.

Practice

Try these in order.

8.6 Define *transpiration*.

[2]

8.7 Out of which tiny holes does water vapour leave the leaf?

[1]

8.8 Name two things that make transpiration faster. [2]

8.9 In translocation, what is a *source*? [1]

8.10 Give one example of a sink. [1]

8.11 Challenge. On a hot, windy day a plant wilts. Explain why, linking transpiration to the water in its cells. [2]

11 Which process moves water from the surfaces of the mesophyll cells into the air spaces during transpiration?

- A** active transport
- B** circulation
- C** evaporation
- D** osmosis

13 Which environmental conditions will result in the highest rate of transpiration?

	high air humidity	very windy	low air temperature
A	no	no	yes
B	no	yes	no
C	yes	yes	yes
D	yes	no	no

15 Which conditions cause the highest rate of transpiration?

- A** high temperature, high wind speed and high humidity
- B** high temperature, high wind speed and low humidity
- C** low temperature, low wind speed and low humidity
- D** low temperature, low wind speed and high humidity

13 During the growing season, tomato plants produce flowers and fruits.

Which parts of a growing tomato plant are sources, and which parts are sinks?

	flowers	fruits	leaves
A	sink	sink	source
B	sink	source	sink
C	source	sink	source
D	source	source	sink

13 What is translocation?

- A** the movement of amino acids and water from sink to source
- B** the movement of starch and water from source to sink
- C** the movement of sucrose and amino acids from source to sink
- D** the movement of sucrose and mineral ions from sink to source

14 Which structures in humans and in plants normally carry amino acids?

	arteries	phloem
A	yes	yes
B	yes	no
C	no	yes
D	no	no

9 The heart and circulation – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
circulatory system	循环系统	_____	_____	_____
pump	泵	_____	_____	_____
heart	心脏	_____	_____	_____
blood vessels	血管	_____	_____	_____
valves	瓣膜	_____	_____	_____
mammal	哺乳动物	_____	_____	_____
double circulation	双循环	_____	_____	_____
lungs	肺	_____	_____	_____
high pressure	高压	_____	_____	_____
oxygen	氧气	_____	_____	_____
muscle	肌肉	_____	_____	_____
septum	隔膜	_____	_____	_____
atrium	心房	_____	_____	_____
ventricle	心室	_____	_____	_____
oxygenated	含氧	_____	_____	_____

English	中文	Write it 3 times (English)
deoxygenated	缺氧	_____

Recall

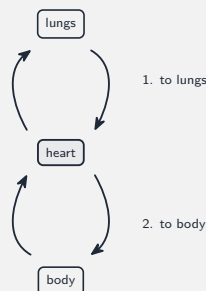
The **circulatory system** 循环系统 carries blood around the body. It has a **pump** 泵 (the **heart** 心脏), **blood vessels** 血管, and **valves** 瓣膜 for one-way flow.

New ideas

Read these first, then do the Practice.

■ 1 Double circulation

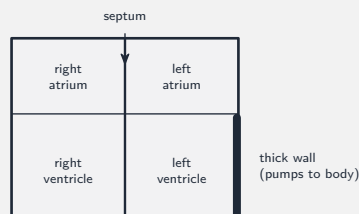
A **mammal** 哺乳动物 has a **double circulation** 双循环: the blood passes through the heart **twice** on each trip round the body —once to the **lungs** 肺, once to the rest of the body.



This lets the blood be pumped again at **high pressure** 高压 before going to the body, so **oxygen** 氧气 arrives quickly.

■ 2 The heart

The heart is made of **muscle** 肌肉. The **septum** 隔膜 divides it into a right and a left side; each side has an **atrium** 心房 (top) and a **ventricle** 心室 (bottom):



- the left ventricle has the **thickest wall** —it pumps blood all round the body;
- the septum keeps **oxygenated** 含氧 and **deoxygenated** 缺氧 blood apart.

Watch out: the **left ventricle** has the thickest wall because it pumps blood all round

the body; the right side only pumps to the lungs. The **septum** keeps oxygenated and deoxygenated blood from mixing.

Practice

Try these in order.

9.1 Name the three parts of the circulatory system. [3]

9.2 What does "double circulation" mean? [2]

9.3 Name the four chambers of the heart. [2]

9.4 Why is the wall of the left ventricle the thickest? [1]

9.5 What is the job of the septum? [1]

9.6 Challenge. Explain why the wall of the left ventricle is much thicker than the wall of the right ventricle. [2]

15 Which statement describes a double circulatory system?

- A** Blood goes through the lungs twice every time it goes round the body.
- B** Blood goes through the kidneys twice every time it goes round the body.
- C** Blood goes through the heart twice every time it goes round the body.
- D** Blood goes through the brain twice every time it goes round the body.

IGCSE Biology: s25 21

15 In a fish, what is the sequence of structures that blood passes through after it leaves the heart?

- A** gills → muscles → heart
- B** gills → heart → muscles → heart
- C** muscles → gills → heart
- D** muscles → heart

IGCSE Biology: s25 22

16 What is an advantage of a double circulatory system?

- A** It allows the mixing of oxygenated and deoxygenated blood.
- B** It can keep blood pressure high in the lungs.
- C** Less carbon dioxide is removed from the body cells.
- D** Oxygen is supplied to body cells by blood at high pressure.

17 Which structure in the heart separates oxygenated and deoxygenated blood?

- A** atrioventricular valve
- B** muscle wall of left atrium
- C** semilunar valve
- D** septum

15 Through which pathway does blood leave the heart?

- A** through arteries from the atria
- B** through arteries from the ventricles
- C** through veins from the atria
- D** through veins from the ventricles

9 Blood vessels and blood – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
arteries	动脉	_____	_____	_____
veins	静脉	_____	_____	_____
valves	瓣膜	_____	_____	_____
capillaries	毛细血管	_____	_____	_____
red blood cells	红细胞	_____	_____	_____
oxygen	氧气	_____	_____	_____
haemoglobin	血红蛋白	_____	_____	_____
white blood cells	白细胞	_____	_____	_____
platelets	血小板	_____	_____	_____
clot	凝血	_____	_____	_____
plasma	血浆	_____	_____	_____

Recall

Blood travels in three kinds of vessel and is made of four parts.

New ideas

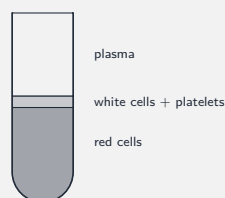
Read these first, then do the Practice.

■ 1 Blood vessels



Vessel	Job
arteries 动脉	carry blood away from the heart, at high pressure
veins 静脉	carry blood back to the heart; have valves 瓣膜
capillaries 毛细血管	one cell thick; let substances pass between blood and cells

■ 2 What blood is made of



- **red blood cells** 红细胞 carry **oxygen** 氧气 using **haemoglobin** 血红蛋白;
- **white blood cells** 白细胞 defend against disease;
- **platelets** 血小板 help the blood **clot** 凝血;
- **plasma** 血浆 is the liquid that carries everything else.

Watch out: **arteries** carry blood *away* from the heart at high pressure (thick walls); **veins** carry it *back* at low pressure and have **valves**; **capillaries** are one cell thick for exchange. "Artery = away" is the way to remember it.

Practice

Try these in order.

9.6 Which vessels carry blood **away** from the heart? [1]

9.7 Why do veins have valves? [1]

9.8 Why are capillary walls only one cell thick? [1]

9.9 Which part of the blood carries oxygen, and what does it use to do so? [2]

9.10 What is the job of the platelets? [1]

9.11 Challenge. Give **two** ways the structure of an artery suits carrying blood at high pressure. [2]

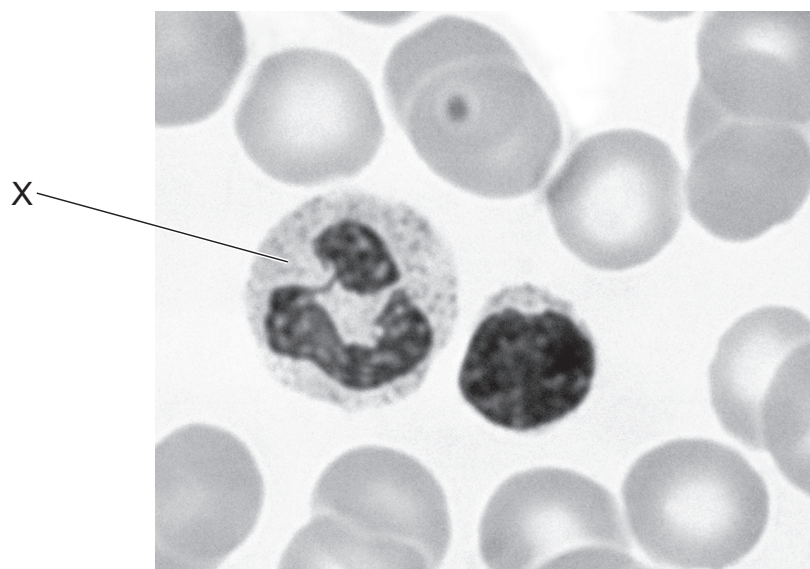
15 What is a feature of veins?

- A** one-cell-thick wall
- B** narrow lumen
- C** thick muscular walls
- D** valves are present

18 Which row shows the features of a vein?

	relative thickness of the wall to total vessel diameter	diameter of the lumen	presence or absence of valves
A	thick	large	absent
B	thick	small	present
C	thin	small	absent
D	thin	large	present

16 The photomicrograph shows some blood cells.



Which row shows the name and function of the cell labelled X?

	name	function
A	lymphocyte	engulfs pathogens
B	lymphocyte	produces antibodies
C	phagocyte	engulfs pathogens
D	phagocyte	produces antibodies

10 Pathogens and defences – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
pathogen	病原体	_____	_____	_____
disease	疾病	_____	_____	_____
transmissible disease	传染病	_____	_____	_____
host	宿主	_____	_____	_____
direct contact	直接接触	_____	_____	_____
body fluids	体液	_____	_____	_____
contaminated	污染	_____	_____	_____
skin	皮肤	_____	_____	_____
mucus	黏液	_____	_____	_____
stomach acid	胃酸	_____	_____	_____
white blood cells	白细胞	_____	_____	_____

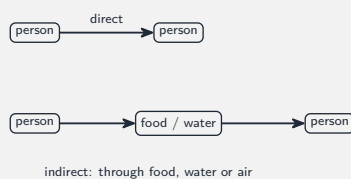
Recall

A **pathogen** 病原体 is an organism that causes **disease** 疾病. A **transmissible disease** 传染病 can pass from one **host** 宿主 to another.

New ideas

Read these first, then do the Practice.

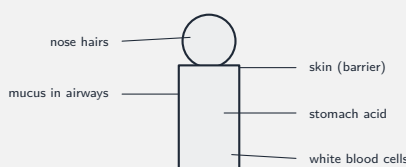
■ 1 How pathogens spread



- by **direct contact** 直接接触—for example through **body fluids** 体液;
- **indirectly** —through **contaminated** 污染 food, water, surfaces or air.

■ 2 The body's defences

Your body keeps most pathogens out, and destroys any that get in:



- **skin** 皮肤—a barrier that covers the body;
- hairs and **mucus** 黏液 in the airways —trap pathogens;
- **stomach acid** 胃酸—kills pathogens in food;
- **white blood cells** 白细胞—destroy pathogens that get inside.

Watch out: defences come in two kinds —*barriers* that keep pathogens out (skin, mucus, stomach acid) and *white blood cells* that destroy any that get in. A **transmissible** disease is one that can pass from host to host.

Practice

Try these in order.

10.1 What is a *pathogen*? [1]

10.2 Give one way a pathogen can spread by direct contact. [1]

10.3 Give one way a pathogen can spread indirectly. [1]

10.4 How does the skin defend the body? [1]

10.5 What does stomach acid do to pathogens in food? [1]

10.6 Challenge. The skin and stomach acid are both defences, but they work in different ways. Explain the difference. [2]

10 Immunity and vaccination – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
antigens	抗原	_____
Antibodies	抗体	_____
lymphocytes	淋巴细胞	_____
complementary	互补	_____
phagocytes	吞噬细胞	_____
vaccine	疫苗	_____
memory cells	记忆细胞	_____
active immunity	主动免疫	_____

Recall

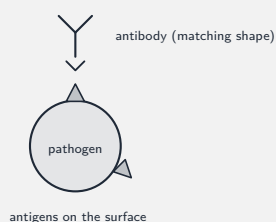
When a pathogen gets inside, special white blood cells fight it. This builds up your immunity.

New ideas

Read these first, then do the Practice.

■ 1 Antigens and antibodies

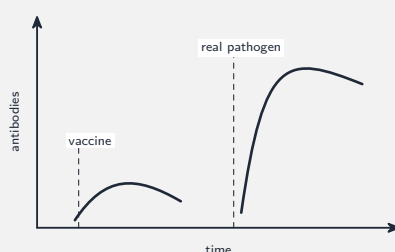
Every pathogen carries **antigens** 抗原 on its surface. **Antibodies** 抗体 (made by **lymphocytes** 淋巴细胞) have a shape **complementary** 互补 to one antigen, so each fits only that pathogen —like an enzyme and its substrate:



When antibodies bind, they destroy the pathogen or mark it for **phagocytes** 吞噬细胞.

■ 2 Vaccination

A **vaccine** 疫苗 puts weakened pathogens (or their antigens) into the body. Your lymphocytes make antibodies and **memory cells** 记忆细胞 that stay for years:



If the real pathogen comes later, the memory cells make antibodies **fast**, so you do not become ill. This is **active immunity** 主动免疫.

Watch out: an **antibody** fits only **one** antigen (like a key in a lock), so it works on just one pathogen. After a vaccine, **memory cells** stay for years and make antibodies *fast* if the real pathogen arrives —that is active immunity.

Practice

Try these in order.

10.6 What is found on the surface of every pathogen? [1]

10.7 Which cells make antibodies? [1]

10.8 Why does an antibody fit only one kind of antigen? [1]

10.9 What do memory cells do if the real pathogen returns? [2]

10.10 What is *active immunity*? [1]

10.11 Challenge. Explain why a person who has been vaccinated against measles does not become ill when they later meet the measles pathogen. [3]

22 Which action would help to limit the development of antibiotic resistance in bacteria?

- A** Use antibiotics frequently to prevent infection by antibiotic-resistant bacteria.
- B** Use antibiotics only to treat bacterial infections.
- C** Use antibiotics to treat all types of infections.
- D** Use antibiotics to treat only viral infections.

17 What is an example of active immunity?

- A** antibody production after infection
- B** antibody transfer from mother to baby in breast milk
- C** antibody transfer from mother to fetus across the placenta
- D** an injection of antibodies that were produced by another individual

26 What can antibiotics treat?

- A** all diseases caused by pathogens
- B** cholera
- C** HIV (human immunodeficiency virus)
- D** rickets

24 What is the reason why antibiotics should be used **only** when essential?

- A** It increases the artificial selection of antibiotic resistant bacteria.
- B** It increases the natural selection of antibiotic resistant bacteria.
- C** It reduces the artificial selection of antibiotic resistant bacteria.
- D** It reduces the natural selection of antibiotic resistant bacteria.

11 Gas exchange and the lungs – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
Gas exchange	气体交换	_____
oxygen	氧气	_____
carbon dioxide	二氧化碳	_____
diffusion	扩散	_____
surface area	表面积	_____
blood supply	血液供应	_____
ventilation	通气	_____
alveoli	肺泡	_____
trachea	气管	_____
bronchi	支气管	_____
bronchioles	细支气管	_____

Recall

Gas exchange 气体交换 is how **oxygen** 氧气 gets into the blood and **carbon dioxide** 二氧化碳 leaves it, by **diffusion** 扩散.

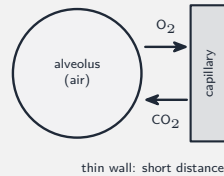
New ideas

Read these first, then do the Practice.

■ 1 A good gas exchange surface

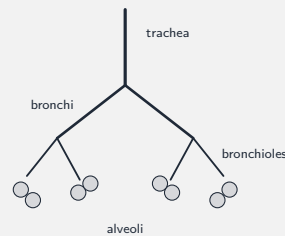
A good surface has: a large **surface area** 表面积, a **thin** wall (short distance), a good **blood supply** 血液供应, and good **ventilation** 通气 with fresh air.

The **alveoli** 肺泡 (tiny air sacs) have all four:



■ 2 The breathing system

Air travels in through these parts:



trachea 气管 (windpipe) → **bronchi** 支气管 → **bronchioles** 细支气管 → **alveoli**.

Watch out: a good gas-exchange surface has a **large surface area**, **thin walls**, a **good blood supply** and good ventilation —the alveoli have all four. Gas exchange is by **diffusion**, not active transport.

Practice

Try these in order.

11.1 What is *gas exchange*? [1]

11.2 Give two features that make the alveoli good for gas exchange. [2]

11.3 In which tiny air sacs does gas exchange happen? [1]

11.4 Put these in order, from the throat to the air sacs: bronchioles, trachea, alveoli, bronchi. [2]

11.5 Which gas diffuses from the alveoli into the blood? [1]

11.6 Challenge. Explain how **two** features of an alveolus make gas exchange fast. [2]

11 Breathing – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
intercostal muscles	肋间肌	_____	_____	_____
ribs	肋骨	_____	_____	_____
diaphragm	膈肌	_____	_____	_____
thorax	胸腔	_____	_____	_____
pressure	压力	_____	_____	_____
water vapour	水蒸气	_____	_____	_____
limewater	石灰水	_____	_____	_____

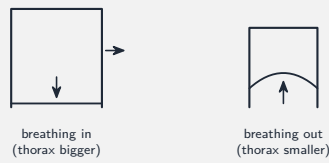
Recall

Breathing moves air in and out of the lungs by changing the size of the chest.

New ideas

Read these first, then do the Practice.

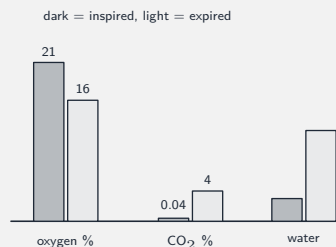
■ 1 How you breathe



Breathing in: the **intercostal muscles** 肋间肌 pull the **ribs** 肋骨 up and out, and the **diaphragm** 膈肌 flattens. The **thorax** 胸腔 gets bigger, the **pressure** 压力 drops, and air is pushed in.

Breathing out is the opposite: the thorax gets smaller, the pressure rises, and air is pushed out.

■ 2 Inspired and expired air



Expired air (breathed out) has **less oxygen**, **more carbon dioxide** and more **water vapour** 水蒸气 than inspired air. You can test for carbon dioxide with **limewater** 石灰水, which turns cloudy.

Watch out: breathing **in**, the diaphragm flattens and the ribs rise, so the thorax gets bigger, the pressure **drops**, and air rushes in. **Breathing** (moving air) is not the same as **respiration** (releasing energy in cells).

Practice

Try these in order.

11.6 When you breathe in, what happens to the diaphragm? [1]

11.7 When you breathe in, does the pressure in the chest rise or fall? [1]

11.8 Give two differences between inspired and expired air. [2]

11.9 Which chemical tests for carbon dioxide, and what does it do? [2]

11.10 During exercise, why do you breathe faster and more deeply? [1]

11.11 Challenge. When you breathe in, the chest volume increases. Explain how this causes air to flow into the lungs. [2]

17 Which muscles in the breathing system contract during inspiration?

- A** external intercostal and diaphragm only
- B** external intercostal and internal intercostal only
- C** external intercostal, internal intercostal and diaphragm
- D** internal intercostal and diaphragm only

6 Which row shows the conditions when diffusion of oxygen into the blood is fastest?

	alveolar surface area	concentration gradient	diffusion path distance
A	high	high	short
B	high	low	short
C	low	high	long
D	low	low	long

18 What helps to keep the trachea open during breathing?

- A** cartilage
- B** cilia
- C** external intercostal muscles
- D** larynx

12 Respiration and energy – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
Respiration	呼吸作用	_____	_____	_____
energy	能量	_____	_____	_____
muscle	肌肉	_____	_____	_____
proteins	蛋白质	_____	_____	_____
cell division	细胞分裂	_____	_____	_____
active transport	主动运输	_____	_____	_____
temperature	温度	_____	_____	_____
Aerobic respiration	有氧呼吸	_____	_____	_____
oxygen	氧气	_____	_____	_____
glucose	葡萄糖	_____	_____	_____

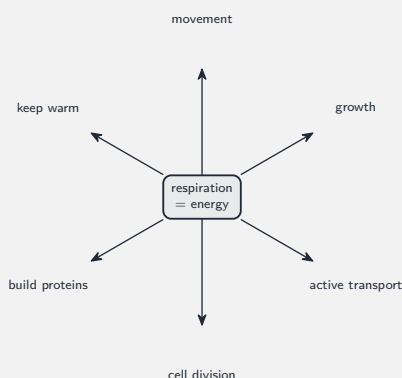
Recall

Respiration 呼吸作用 is the release of **energy** 能量 from food. It happens in **every** living cell, all the time. (It is **not** the same as breathing.)

New ideas

Read these first, then do the Practice.

■ 1 What the energy is for



Cells use the energy for **muscle** 肌肉 contraction, building **proteins** 蛋白质, **cell division** 细胞分裂, **active transport** 主动运输, growth, and keeping a steady body **temperature** 温度.

■ 2 Aerobic respiration

Aerobic respiration 有氧呼吸 uses **oxygen** 氧气 to break down **glucose** 葡萄糖, releasing a **lot** of energy:



Watch out: respiration releases energy *inside cells*—it is **not** the same as breathing (which just moves air). **Aerobic** respiration uses oxygen and releases a **lot** of energy: glucose + oxygen → carbon dioxide + water.

Practice

Try these in order.

12.1 What is *respiration*? [1]

12.2 Give two jobs the body uses respiration energy for. [2]

12.3 Is respiration the same as breathing? [1]

12.4 Write the word equation for aerobic respiration. [2]

12.5 Which gas does aerobic respiration use? [1]

12.6 Challenge. A muscle cell and a root cell both respire all the time. Suggest one use of the energy in each. [2]

19 The processes listed occur in living organisms.

- 1 cell division
- 2 diffusion
- 3 muscle contraction
- 4 osmosis

Which processes require energy from respiration?

- A** 1, 2, 3 and 4 **B** 1 and 3 only **C** 2 and 3 only **D** 3 and 4 only

12 Anaerobic respiration – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
Anaerobic respiration	无氧呼吸	_____	_____	_____
yeast	酵母	_____	_____	_____
alcohol	酒精	_____	_____	_____
muscles	肌肉	_____	_____	_____
lactic acid	乳酸	_____	_____	_____
oxygen debt	氧债	_____	_____	_____
liver	肝脏	_____	_____	_____

Recall

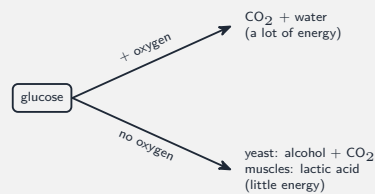
When there is plenty of oxygen, cells respire aerobically. When there is not enough, they can still get some energy without oxygen.

New ideas

Read these first, then do the Practice.

■ 1 Aerobic vs anaerobic

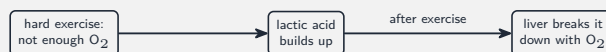
Anaerobic respiration 无氧呼吸 releases energy from glucose **without** oxygen. It gives **much less** energy:



- in **yeast** 酵母: glucose → **alcohol** 酒精 + carbon dioxide (used to make bread and drinks);
- in **muscles** 肌肉: glucose → **lactic acid** 乳酸.

■ 2 Oxygen debt

During hard exercise, muscles cannot get enough oxygen, so they make lactic acid — this builds an **oxygen debt** 氧债:



Afterwards, you keep breathing hard so the **liver** 肝脏 can break the lactic acid down.

Watch out: **anaerobic** respiration releases **much less** energy than aerobic (it only partly breaks down the glucose). In muscles it makes **lactic acid**; in yeast it makes **alcohol + carbon dioxide** — know which is which.

Practice

Try these in order.

12.6 How is anaerobic respiration different from aerobic respiration? [2]

12.7 What does yeast make when it respire without oxygen? [1]

12.8 What does anaerobic respiration make in your muscles? [1]

12.9 What is the *oxygen debt*? [1]

12.10 Which organ breaks down the lactic acid afterwards?

[1]

12.11 Challenge. After a sprint, an athlete keeps breathing hard for several minutes. Explain why, using the idea of oxygen debt. [2]

2 (a) Alveoli are the gas exchange surface in humans.

State **three** features of alveoli that make them an effective gas exchange surface.

1

2

3

[3]

(b) Fig. 2.1 is a diagram of the human breathing system.

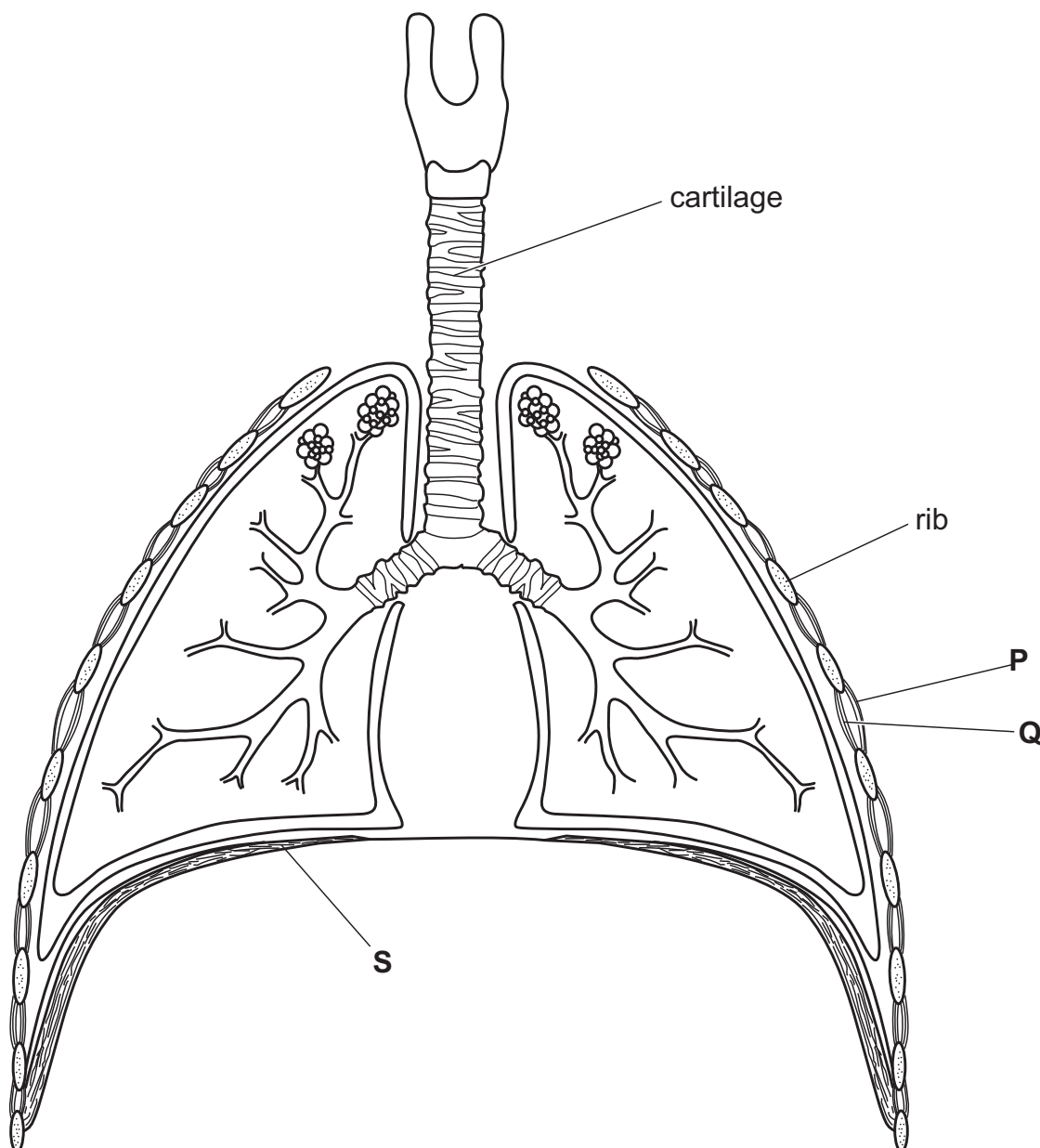


Fig. 2.1

(i) Three muscles involved in inspiration are labelled **P**, **Q** and **S** in Fig. 2.1.

Identify the letters in Fig. 2.1 that label the muscles which contract during inspiration.

..... [1]

(ii) State the function of cartilage in the breathing system.

[1]

(c) (i) State the balanced chemical equation for aerobic respiration.

[2]

(ii) During physical activity breathing changes.

Explain the mechanism that links the increase in physical activity to the changes in breathing.

[3]

[Total: 10]

19 What is produced by anaerobic respiration in human muscles?

	carbon dioxide	lactic acid	water
A	✓	✓	✗
B	✓	✗	✓
C	✗	✓	✗
D	✗	✗	✓

key

✓ = substance is produced

✗ = substance is **not** produced

17 A person exercised vigorously for one minute and then rested for one hour.

Which statements about lactic acid are correct?

- 1 During exercise, lactic acid is produced in the muscles and diffuses into the blood.
- 2 The blood transports lactic acid to the liver.
- 3 Lactic acid is broken down by anaerobic respiration.

A 1, 2 and 3 **B** 1 and 2 only **C** 2 and 3 only **D** 2 only

19 Yeast can respire aerobically and anaerobically.

For each molecule of glucose used in yeast, how many more molecules of carbon dioxide gas are produced by aerobic respiration compared with anaerobic respiration?

- A** 1 more
B 2 more
C 4 more
D 6 more

13 Excretion and the kidneys – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
Excretion	排泄	_____	_____	_____
carbon dioxide	二氧化碳	_____	_____	_____
respiration	呼吸作用	_____	_____	_____
lungs	肺	_____	_____	_____
urea	尿素	_____	_____	_____
liver	肝脏	_____	_____	_____
kidneys	肾脏	_____	_____	_____
ions	离子	_____	_____	_____
urine	尿液	_____	_____	_____
ureters	输尿管	_____	_____	_____
bladder	膀胱	_____	_____	_____
urethra	尿道	_____	_____	_____

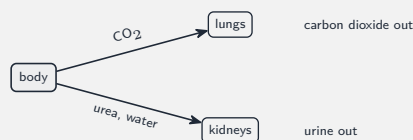
Recall

Excretion 排泄 is removing the waste products your body's reactions make, and any substances in excess.

New ideas

Read these first, then do the Practice.

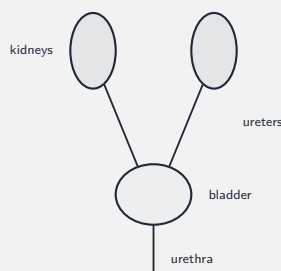
■ 1 Two main wastes



- **carbon dioxide** 二氧化碳—made in **respiration** 呼吸作用, breathed out through the **lungs** 肺;
- **urea** 尿素—made in the **liver** 肝脏, removed by the **kidneys** 肾脏 with excess water and **ions** 离子.

■ 2 The urinary system

The kidneys clean the blood and make **urine** 尿液:



kidneys → **ureters** 输尿管 → **bladder** 膀胱 → **urethra** 尿道 → out.

Watch out: **excretion** removes waste the body *makes* (carbon dioxide, urea) — it is not the same as *egestion* (undigested food). Carbon dioxide leaves through the **lungs**; urea is made in the **liver** but removed by the **kidneys**.

Practice

Try these in order.

13.1 What is *excretion*?

[1]

13.2 Which waste gas leaves the body through the lungs?

[1]

13.3 Where in the body is urea made? [1]

13.4 Which organs remove urea from the blood? [1]

13.5 Put these in order, from kidney to outside: bladder, urethra, ureter, kidney. [2]

13.6 Challenge. Carbon dioxide and urea are both excreted, but leave by different organs. State the organ that removes each, and where each waste is made. [3]

13 Inside the kidney – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
Filtration	过滤	_____	_____	_____
glomerulus	肾小球	_____	_____	_____
glucose	葡萄糖	_____	_____	_____
Reabsorption	重吸收	_____	_____	_____
amino acids	氨基酸	_____	_____	_____
liver	肝脏	_____	_____	_____
deamination	脱氨基	_____	_____	_____
urea	尿素	_____	_____	_____
toxic	有毒	_____	_____	_____

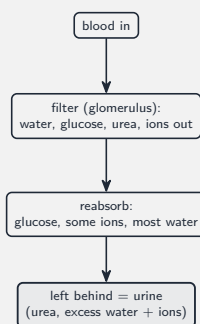
Recall

Each kidney has millions of tiny tubes that clean the blood in two steps.

New ideas

Read these first, then do the Practice.

■ 1 How a kidney cleans blood



1. **Filtration** 过滤: at the **glomerulus** 肾小球, water, **glucose** 葡萄糖, urea and ions are forced out of the blood.
2. **Reabsorption** 重吸收: **all** the glucose, **some** ions and **most** of the water are taken back into the blood.

What is left —urea and excess water and ions —is the urine.

■ 2 Where urea comes from



The body cannot store extra **amino acids** 氨基酸. The **liver** 肝脏 breaks them down (**deamination** 脱氨基) to make **urea** 尿素, which is **toxic** 有毒, so the kidneys remove it.

Watch out: the kidney cleans blood in two steps —**filtration** forces small molecules out (including glucose), then **reabsorption** takes back *all* the glucose, *some* ions and *most* of the water. Glucose is normally **not** in urine.

Practice

Try these in order.

13.6 What happens during filtration in the kidney? [1]

13.7 Name two things that are reabsorbed back into the blood. [2]

13.8 What is left behind to form the urine? [1]

13.9 Where is urea made, and from what? [2]

13.10 Why must urea be removed from the body? [1]

13.11 Challenge. Healthy urine contains no glucose, even though glucose is filtered out of the blood. Explain why. [2]

19 What shows the pathway of urea from where it is produced to where it is excreted?

- A** kidney → renal artery → heart → lungs → heart → renal vein → bladder
- B** kidney → renal vein → heart → lungs → heart → renal artery → bladder
- C** liver → hepatic artery → heart → lungs → heart → renal artery → kidney
- D** liver → hepatic vein → heart → lungs → heart → renal artery → kidney

IGCSE Biology: s25 21

20 What is a role of the glomerulus?

- A** assembling amino acids into proteins
- B** filtration of water, glucose, urea and ions from the blood
- C** reabsorption of glucose, ions and water back into the blood
- D** removal of the nitrogen-containing part of amino acids to form urea

IGCSE Biology: s25 23

22 What can be broken down to form urea?

- A** amino acids
- B** fatty acids
- C** sugars
- D** vitamins

IGCSE Biology: m25 22

20 In a healthy human, in which blood vessel would you find the **lowest** concentration of urea?

- A** hepatic artery
- B** hepatic vein
- C** renal artery
- D** renal vein

14 The nervous system – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
coordinate	协调	_____	_____	_____
nervous system	神经系统	_____	_____	_____
electrical impulses	电脉冲	_____	_____	_____
neurones	神经元	_____	_____	_____
central nervous system	中枢神经系统	_____	_____	_____
brain	大脑	_____	_____	_____
spinal cord	脊髓	_____	_____	_____
peripheral nervous system	周围神经系统	_____	_____	_____
impulse	冲动	_____	_____	_____
reflex	反射	_____	_____	_____
response	反应	_____	_____	_____
stimulus	刺激	_____	_____	_____
receptor	感受器	_____	_____	_____
effector	效应器	_____	_____	_____

Recall

Your body must react to changes and **coordinate** 协调 its parts. The **nervous system** 神经系统 does this with fast **electrical impulses** 电脉冲 along **neurones** 神经元.

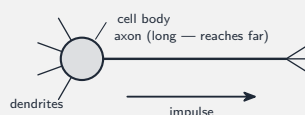
New ideas

Read these first, then do the Practice.

■ 1 Parts of the nervous system

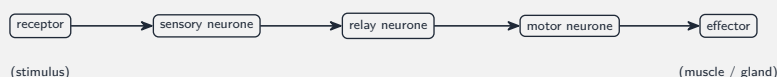
- the **central nervous system** 中枢神经系统 (CNS) —the **brain** 大脑 and **spinal cord** 脊髓;
- the **peripheral nervous system** 周围神经系统—all the nerves outside the CNS.

A neurone carries an **impulse** 冲动 along a long fibre:



■ 2 The reflex arc

A **reflex** 反射 is a fast, automatic **response** 反应 to a **stimulus** 刺激. It follows a fixed path:



receptor 感受器 → sensory → relay → motor neurone → **effector** 效应器 (a muscle or gland).

Watch out: a **reflex** is fast and automatic because the impulse takes a fixed short path (the reflex arc) and does **not** wait for the brain to decide. The order is **receptor** → **sensory** → **relay** → **motor** → **effector**.

Practice

Try these in order.

14.1 What are the two parts of the central nervous system?

[2]

14.2 What carries impulses around the body?

[1]

14.3 What is a *reflex action*?

[1]

14.4 Put the reflex arc in order: motor neurone, receptor, effector, sensory neurone, relay neurone.

[2]

14.5 Give one example of an effector.

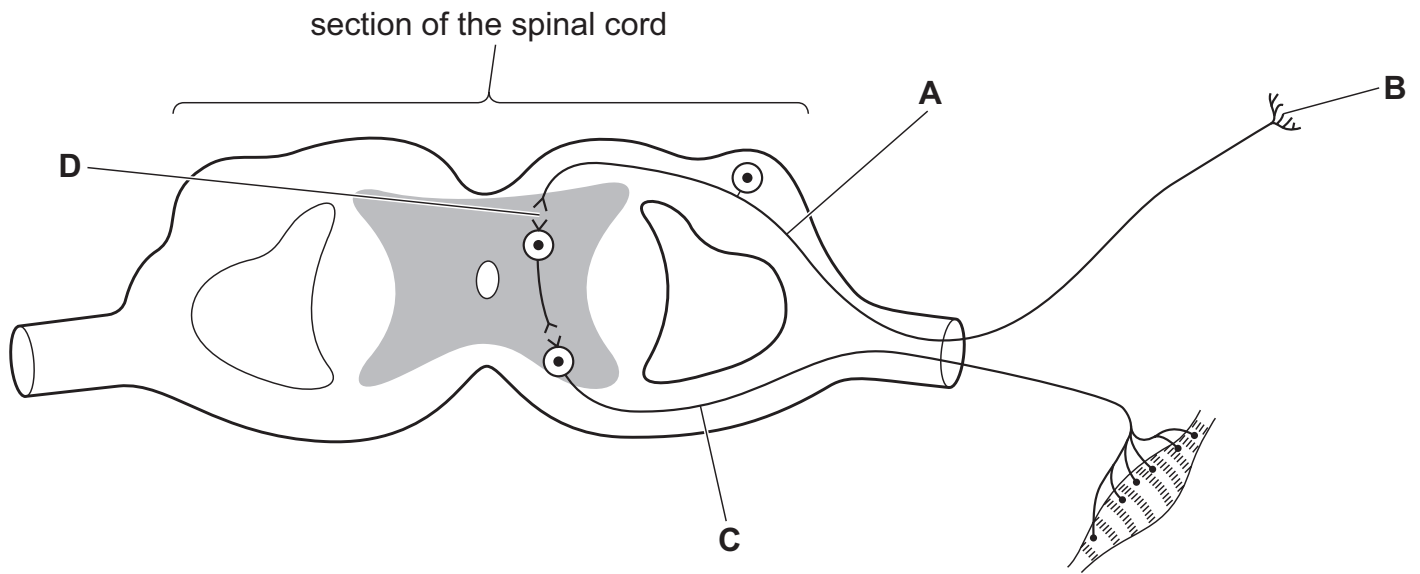
[1]

14.6 Challenge. Explain why a reflex action, like pulling your hand off a hot object, is faster than a thought-out movement.

[2]

18 The diagram shows the parts of the nervous system involved in a reflex arc.

Which letter identifies a synapse?



- 21** When moving from an area with low light intensity to an area with high light intensity, how do the circular and radial muscles of the iris react?

	circular muscles	radial muscles
A	contract	no change
B	contract	relax
C	relax	contract
D	relax	no change

- 20** Which row shows the state of the ciliary muscles and suspensory ligaments when the eye is focusing on a near object?

	ciliary muscles	suspensory ligaments
A	contracted	slack
B	contracted	tense
C	relaxed	slack
D	relaxed	tense

- 22** Which row shows the function of rod cells?

	night vision	colour vision
A	yes	yes
B	yes	no
C	no	yes
D	no	no

14 Hormones and homeostasis – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
hormones	激素	_____
gland	腺体	_____
target organs	靶器官	_____
adrenaline	肾上腺素	_____
Homeostasis	稳态	_____
pancreas	胰腺	_____
liver	肝脏	_____
insulin	胰岛素	_____
glycogen	糖原	_____
glucagon	胰高血糖素	_____
Type 1 diabetes	一型糖尿病	_____

Recall

Besides nerves, the body uses **hormones** 激素—chemicals made by glands and carried in the blood.

New ideas

Read these first, then do the Practice.

■ 1 Nerves vs hormones

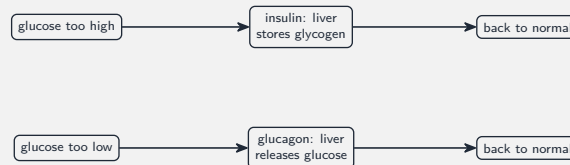
A hormone is made by a **gland** 腺体 and carried in the blood to its **target organs** 靶器官:

	nervous	hormonal
speed	fast	slower
lasts	short	longer
travels by	nerves	blood

For example, **adrenaline** 肾上腺素 prepares the body for action ('fight or flight').

■ 2 Controlling blood glucose

Homeostasis 稳态 means keeping a steady internal environment. The **pancreas** 胰腺 and **liver** 肝脏 keep blood glucose steady:



- **insulin** 胰岛素 **lowers** high glucose (stored as **glycogen** 糖原);
- **glucagon** 胰高血糖素 **raises** low glucose.

In **Type 1 diabetes** 一型糖尿病 the pancreas cannot make insulin.

Watch out: **nervous** control is fast and short-lived (along nerves); **hormonal** control is slower but longer-lasting (through the blood). For blood glucose, **insulin** **lowers** it and **glucagon** **raises** it —opposite hormones.

Practice

Try these in order.

14.6 What is a *hormone*?

[1]

14.7 Give one difference between nervous and hormonal control.

[1]

14.8 What does insulin do when blood glucose is too high? [2]

14.9 What does glucagon do when blood glucose is too low? [1]

14.10 What is the problem in Type 1 diabetes? [1]

14.11 Challenge. After a sugary meal a person's blood glucose rises. Explain how insulin brings it back to normal. [3]

24 Which row shows the correct speed and duration for the type of control?

	type of control	speed of action	duration of effect
A	hormonal	fast	short
B	hormonal	slow	long
C	nervous	fast	long
D	nervous	slow	short

25 Which organ produces glucagon?

- A** adrenal gland
- B** liver
- C** ovary
- D** pancreas

25 Which hormones increase the blood glucose concentration in humans?

- A** adrenaline and glucagon
- B** adrenaline and insulin
- C** glucagon only
- D** insulin only

22 Which actions can prevent a mammal's internal body temperature falling too low?

- A** shivering and vasoconstriction
- B** shivering and vasodilation
- C** sweating and vasoconstriction
- D** sweating and vasodilation

24 What is a response of the human body to overheating?

- A** vasoconstriction of arterioles
- B** vasoconstriction of veins
- C** vasodilation of arterioles
- D** vasodilation of veins

22 The liver and the pancreas work together to control the concentration of glucose in the blood.

Which statement is correct?

- A** The liver converts the small molecule glucose into the large molecule glucagon.
- B** The liver releases the hormone insulin when blood glucose concentration is too high.
- C** The pancreas does **not** respond to an increase in blood glucose concentration.
- D** The pancreas responds to a fall in the blood glucose concentration by increasing the release of the hormone glucagon.

25 A student writes four statements about auxin.

- 1 Auxin becomes more concentrated on the lower side of a horizontal stem.
- 2 Auxin becomes more concentrated on the side of the shoot that has more light.
- 3 Auxin is made in the shoot tip.
- 4 Auxin prevents cell elongation in the shoot.

Which statements describe what happens during chemical control of plant growth?

- A** 1, 2 and 4 **B** 1 and 2 only **C** 1 and 3 **D** 2, 3 and 4

IGCSE Biology: **s25 21**

25 What is an example of phototropism?

- A** the growth of a root in the direction of gravity
B the growth of a shoot towards light
C the release of energy from glucose using light
D the synthesis of glucose using light

IGCSE Biology: **m25 22**

23 In the dark, plant shoots grow upwards and roots grow downwards.

What causes these responses?

	gravitropism	phototropism
A	no	no
B	no	yes
C	yes	no
D	yes	yes

15 Drugs and antibiotics – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
drug	药物	_____
chemical reactions	化学反应	_____
Antibiotics	抗生素	_____
bacterial	细菌	_____
infections	感染	_____
viruses	病毒	_____

Recall

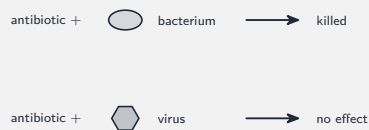
A **drug** 药物 is any substance taken into the body that changes its **chemical reactions** 化学反应. Many drugs are medicines.

New ideas

Read these first, then do the Practice.

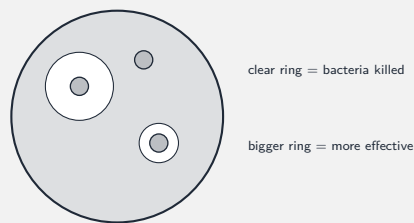
■ 1 Antibiotics

Antibiotics 抗生素 are drugs that treat **bacterial** 细菌 **infections** 感染—they kill bacteria or stop them growing. They have **no** effect on **viruses** 病毒, so they cannot cure a cold or the flu:



■ 2 Testing antibiotics

To find which antibiotic works best, discs soaked in different antibiotics are placed on a plate covered with bacteria. A **clear ring** with no growth shows the antibiotic killed the bacteria:



Watch out: **antibiotics** kill *bacteria* only—they have **no** effect on **viruses**, so they cannot cure a cold or flu. On a test plate, a *bigger* clear ring means a *more* effective antibiotic.

Practice

Try these in order.

15.1 What is a *drug*? [1]

15.2 What do antibiotics treat? [1]

15.3 Why can't antibiotics cure a cold or the flu? [1]

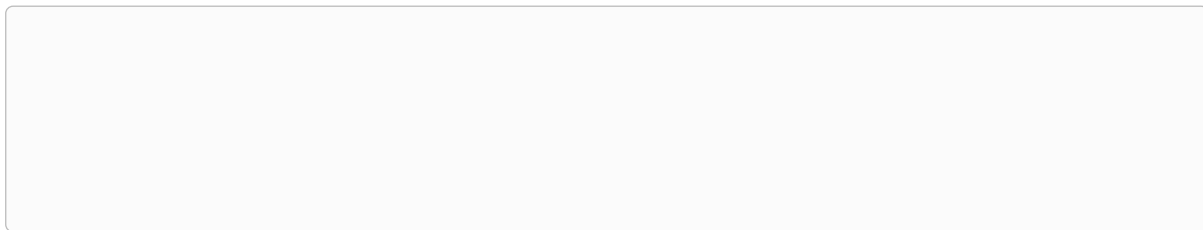
15.4 On a test plate, what does a clear ring around a disc show? [1]

15.5 What does a bigger clear ring mean? [1]

15.6 Challenge. A doctor refuses to give antibiotics for a patient's cold. Explain why

this is the right decision.

[2]



15 Antibiotic resistance – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
resistant	耐药	_____
strain	菌株	_____
viral	病毒性	_____

Recall

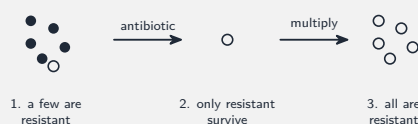
If antibiotics are overused, bacteria can become resistant —the antibiotic stops working.

New ideas

Read these first, then do the Practice.

■ 1 How resistance spreads

Some bacteria are **resistant** 耐药—the antibiotic does not kill them. They survive and multiply:



A resistant **strain** 菌株 like **MRSA** can then spread.

■ 2 Slowing resistance down

- ✓ only use when really needed
- ✓ always finish the whole course
- ✓ never use for viruses (colds, flu)

- only use antibiotics when they are **really needed**;
- always **finish the whole course**;
- never use them for **viral** 病毒性 infections.

Watch out: resistance spreads by **natural selection** —the antibiotic kills the non-resistant bacteria, leaving the resistant ones to multiply. To slow it: only use antibiotics when needed, **finish the whole course**, and never use them for viruses.

Practice

Try these in order.

15.6 What does it mean to say bacteria are *resistant* to an antibiotic? [1]

15.7 Why do resistant bacteria become more common after an antibiotic is used? [2]

15.8 Name a resistant type of bacterium. [1]

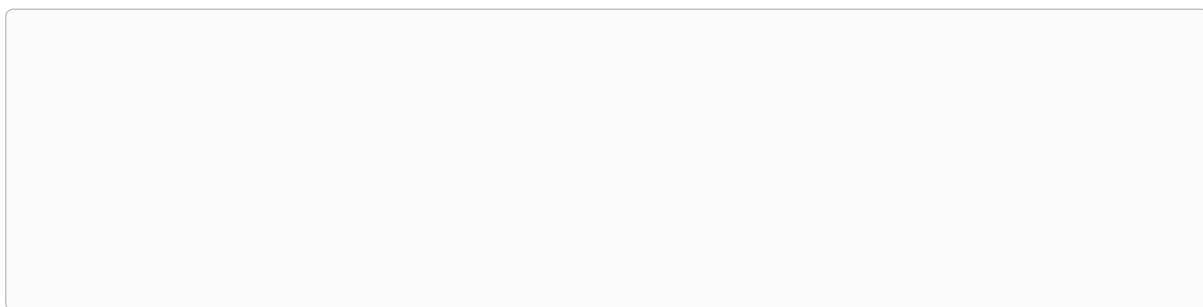
15.9 Give two ways to slow down antibiotic resistance. [2]

15.10 Should you stop taking antibiotics as soon as you feel better? [1]

15.11 Challenge. Explain how a population of bacteria can become almost entirely

resistant to an antibiotic.

[3]



16 Reproduction and flowers – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
Reproduction	生殖	_____	_____	_____
asexual reproduction	无性生殖	_____	_____	_____
variation	变异	_____	_____	_____
sexual reproduction	有性生殖	_____	_____	_____
gametes	配子	_____	_____	_____
fertilisation	受精	_____	_____	_____
zygote	合子	_____	_____	_____
stamen	雄蕊	_____	_____	_____
anther	花药	_____	_____	_____
pollen	花粉	_____	_____	_____
carpel	雌蕊	_____	_____	_____
stigma	柱头	_____	_____	_____
style	花柱	_____	_____	_____
ovary	子房	_____	_____	_____
Pollination	传粉	_____	_____	_____

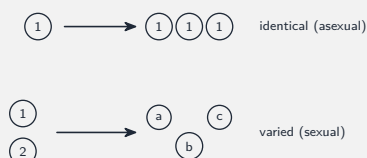
Recall

Reproduction 生殖 makes new organisms of the same kind. There are two types.

New ideas

Read these first, then do the Practice.

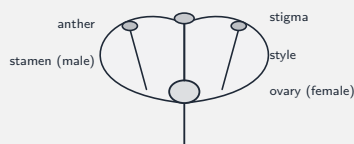
■ 1 Asexual vs sexual



- **asexual reproduction** 无性生殖: **one** parent; offspring are genetically identical (clones), so no **variation** 变异.
- **sexual reproduction** 有性生殖: **two** parents; two **gametes** 配子 (sex cells) join (**fertilisation** 受精) to make a **zygote** 合子; offspring show variation.

■ 2 Parts of a flower

A flower has male and female parts:



- the **stamen** 雄蕊 (male) = an **anther** 花药 (makes **pollen** 花粉) on a filament;
- the **carpel** 雌蕊 (female) = a **stigma** 柱头, a **style** 花柱 and an **ovary** 子房.

Pollination 传粉 is the transfer of pollen from an anther to a stigma.

Watch out: **asexual** reproduction has *one* parent and makes identical clones (no variation); **sexual** reproduction has *two* parents and gives variation. **Pollination** (pollen reaching a stigma) is not the same as **fertilisation** (the nuclei joining).

Practice

Try these in order.

16.1 How many parents does asexual reproduction need?

[1]

16.2 Why do the offspring of sexual reproduction show variation? [1]

16.3 What is *fertilisation*? [1]

16.4 Name the male part of a flower and the female part. [2]

16.5 What is *pollination*? [1]

16.6 Challenge. A grower wants identical copies of a prize plant. State which type of reproduction gives this, and explain why the offspring are identical. [2]

23 A gardener has a strawberry plant that produces large, sweet fruits.

How does the gardener grow more strawberry plants that **all** produce large, sweet fruits?

- A** Use asexual reproduction to produce offspring with no genetic variation.
- B** Use asexual reproduction to produce seeds that will grow into new plants.
- C** Use sexual reproduction and self-pollination as they only have one plant.
- D** Use sexual reproduction to reduce variation in the offspring.

23 What is an example of asexual reproduction?

- A** a single bacterium dividing to produce two genetically identical bacteria
- B** a mammal giving birth to four offspring
- C** a female bird laying six eggs which will hatch into the same species
- D** a tomato plant producing fruits which contain many seeds

28 What are the characteristics of asexual reproduction?

	fusion of gamete nuclei	genetic variety in the offspring
A	yes	yes
B	yes	no
C	no	yes
D	no	no

30 Which row correctly links the named process with its description?

	process	description
A	menstruation	release of an egg
B	menstruation	shedding of the lining of the uterus
C	ovulation	fusion of nuclei
D	ovulation	start of puberty

24 Where does fertilisation occur in a plant?

- A** ovule
- B** pollen grain
- C** pollen tube
- D** stigma

IGCSE Biology: s25 22

29 Which description of cross-pollination is correct?

- A** the transfer of pollen grains from the anther of one plant to the stigma on a different plant
- B** the transfer of pollen grains from the anther to the stigma on the same plant
- C** the transfer of pollen grains from the stigma of one plant to the anther on a different plant
- D** the transfer of pollen grains from the stigma to the anther on the same plant

IGCSE Biology: s25 23

28 Which statement about pollination is correct?

- A** Self-pollination increases the ability of the population to respond to changes in the environment by increasing variation.
- B** Self-pollination increases the ability of the population to respond to changes in the environment by reducing variation.
- C** Self-pollination reduces the ability of the population to respond to changes in the environment by increasing variation.
- D** Self-pollination reduces the ability of the population to respond to changes in the environment by reducing variation.

16 Human reproduction – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
gamete	配子	_____
tail	尾巴	_____
Fertilisation	受精	_____
nucleus	细胞核	_____
menstrual cycle	月经周期	_____
uterus	子宫	_____
period	月经	_____
ovulation	排卵	_____

Recall

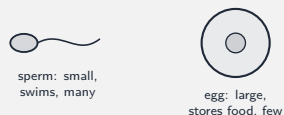
In humans, a male **gamete** 配子 (sperm) joins a female gamete (egg) to make a new individual.

New ideas

Read these first, then do the Practice.

■ 1 The gametes

The sperm and egg are each suited to their job:

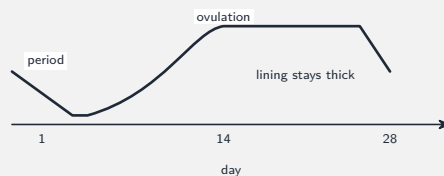


	Sperm	Egg cell
size	very small	large
number	millions	few
moves?	yes (swims with a tail 尾巴)	no

Fertilisation 受精 joins the **nucleus** 细胞核 of a sperm with that of an egg.

■ 2 The menstrual cycle

The **menstrual cycle** 月经周期 (about 28 days) prepares the **uterus** 子宫 for a possible pregnancy:



- days 1–5: the lining breaks down (a **period** 月经);
- around day 14: an egg is released (**ovulation** 排卵);
- if the egg is not fertilised, the cycle starts again.

Watch out: the **sperm** is small, numerous and swims; the **egg** is large, few and cannot move —each is adapted to its job. **Ovulation** (egg released, about day 14) is not the same as the **period** (lining shed, days 1–5).

Practice

Try these in order.

16.6 Give two ways a sperm is different from an egg cell.

[2]

16.7 How does a sperm move?

[1]

16.8 What is *fertilisation* in humans? [1]

16.9 About how long is the menstrual cycle? [1]

16.10 What happens at ovulation, and on about which day? [2]

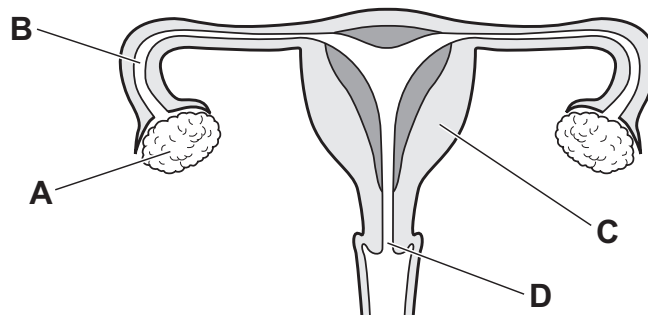
16.11 Challenge. The sperm cell is adapted for its job. Explain how **two** of its features help it fertilise the egg. [2]

26 Which statement describes the net direction of movement of a substance across the placenta?

- A** Carbon dioxide moves from the mother's blood to the fetus's blood.
- B** Glucose moves from the fetus's blood to the mother's blood.
- C** Glycogen moves from the mother's blood to the fetus's blood.
- D** Urea moves from the fetus's blood to the mother's blood.

27 The diagram shows the human female reproductive system.

Which label identifies the uterus?



26 A person has a 28-day menstrual cycle.

On which day is the lining of the uterus thickest?

- A** 2 **B** 4 **C** 9 **D** 21

IGCSE Biology: w25 22

25 Which substance is a hormone that is involved in the development and regulation of male secondary sexual characteristics?

- A** insulin
B glucagon
C lactase
D testosterone

IGCSE Biology: w25 23

29 Which hormone is produced by cells in the placenta of a developing fetus?

- A** FSH
B LH
C testosterone
D progesterone

IGCSE Biology: m25 22

27 Which statement correctly describes the effect of a hormone in a human menstrual cycle that lasts for 28 days?

- A** FSH causes maturation of an egg up to day 21.
B LH stimulates the release of an egg on day 14.
C Oestrogen maintains the uterus lining between days 14 and 28.
D Progesterone causes the repair and thickening of the uterus lining between days 4 to 14.

28 Which methods can transmit HIV?

- 1 hugging a person infected with HIV
- 2 sharing a needle with a person infected with HIV
- 3 using a plate that a person infected with HIV has used

A 1, 2 and 3 **B** 1 only **C** 2 and 3 only **D** 2 only

17 Chromosomes, genes and DNA – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
Chromosomes	染色体	_____
genes	基因	_____
codes	编码	_____
protein	蛋白质	_____
allele	等位基因	_____
sex chromosomes	性染色体	_____
ratio	比例	_____

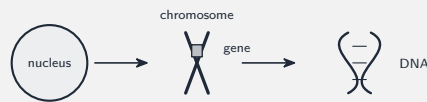
Recall

Chromosomes 染色体 are made of **DNA**, which carries the genetic information in units called **genes** 基因.

New ideas

Read these first, then do the Practice.

■ 1 Chromosomes, genes and DNA



- a **gene** is a length of DNA that **codes** 编码 for one **protein** 蛋白质;
- an **allele** 等位基因 is one form of a gene (e.g. a brown or a blue allele for eye colour).

■ 2 Boy or girl?

Sex is decided by the **sex chromosomes** 性染色体: females are **XX**, males are **XY**. An egg always carries X; a sperm carries X or Y, so the **sperm** decides the sex:

		father (sperm)		
		X	Y	
mother (eggs)	X	XX	XY	XX = girl
	X	XX	XY	XY = boy
ratio 1 : 1				

This gives a 1:1 **ratio** 比例 of girls to boys.

Watch out: a **gene** is a length of DNA coding for one protein; an **allele** is one *form* of that gene —don't use the words interchangeably. The **sperm** decides a baby's sex (it carries X or Y); the egg always carries X.

Practice

Try these in order.

17.1 What are chromosomes made of? [1]

17.2 What is a *gene*? [1]

17.3 What is an *allele*? [1]

17.4 What are the sex chromosomes of a male and of a female? [2]

17.5 Which parent's gamete decides the baby's sex, and why?

[2]

17.6 Challenge. Explain why about half of all babies are boys and half are girls, using the sex chromosomes.

[3]

30 Why are lymphocytes the only cells that produce antibody proteins?

- A** Lymphocytes express all the genes in the nucleus.
- B** Lymphocytes have twice as many genes as other cells.
- C** Other cells do **not** have the genes for antibodies.
- D** The genes for antibodies are only expressed in lymphocytes.

31 During protein synthesis, what is the function of the ribosome?

- A** It assembles amino acids in a chain.
- B** It carries a copy of a gene to the cytoplasm.
- C** It contains the code for the synthesis of a protein.
- D** It determines the order of bases in the protein.

29 Which term is defined as a length of DNA that codes for a protein?

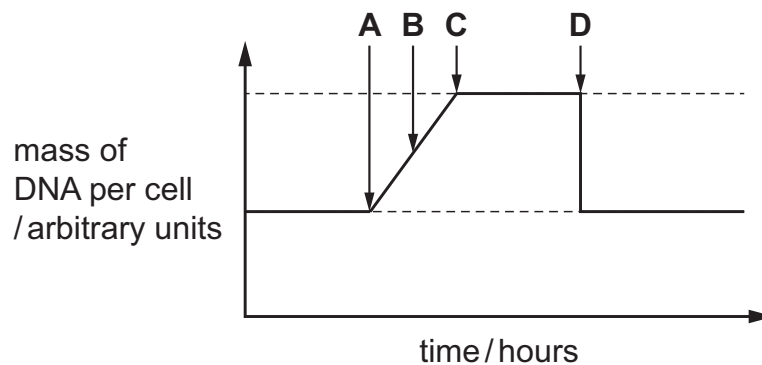
- A** amino acid
- B** chromosome
- C** gene
- D** mutation

33 What are stem cells?

- A** specialised cells that divide by meiosis to produce daughter cells
- B** specialised cells that divide by mitosis to produce daughter cells
- C** unspecialised cells that divide by meiosis to produce daughter cells
- D** unspecialised cells that divide by mitosis to produce daughter cells

31 The graph shows how the mass of DNA changes during a mitotic cell division.

Where on the graph are **two** cells formed?



17 Inheritance and crosses – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
genotype	基因型	_____
phenotype	表现型	_____
dominant	显性	_____
recessive	隐性	_____
homozygous	纯合	_____
heterozygous	杂合	_____
Punnett square	庞纳特方格	_____

Recall

We use special words to describe what alleles an organism has, and what it looks like.

New ideas

Read these first, then do the Practice.

■ 1 Key words

Word	Meaning
genotype 基因型	the alleles an organism has
phenotype 表现型	the features you can see
dominant 显性	shown even with one copy (capital letter)
recessive 隐性	shown only with two copies (small letter)
homozygous 纯合	two same alleles (BB or bb)
heterozygous 杂合	two different alleles (Bb)

$BB \longrightarrow$ brown eyes
 $Bb \longrightarrow$ brown eyes
 $bb \longrightarrow$ blue eyes

B (brown) is dominant
 b (blue) is recessive

■ 2 A monohybrid cross

A **Punnett square** 庞纳特方格 predicts the offspring. Two heterozygous parents ($Bb \times Bb$) give a **3:1** ratio:

	B	b	
B	BB	Bb	3 dominant ($B_$) 1 recessive (bb) ratio 3 : 1
b	Bb	bb	

Watch out: **genotype** = the alleles you have; **phenotype** = the features you can see. A **recessive** allele only shows when there is *no* dominant allele (two recessive copies, e.g. bb). A $Bb \times Bb$ cross gives a **3:1** phenotype ratio.

Practice

Try these in order.

17.6 What is the difference between *genotype* and *phenotype*? [2]

17.7 What does *homozygous* mean? [1]

17.8 A recessive allele shows in the phenotype only when...? [1]

17.9 Two heterozygous parents ($Bb \times Bb$) are crossed. What ratio of phenotypes do you expect? [1]

17.10 Write the four offspring genotypes from a $Bb \times Bb$ cross. [2]

17.11 Challenge. Two brown-eyed parents, both **Bb**, have a child. State the chance the child has blue eyes (**bb**), and show the cross that gives your answer. [3]

28 Which statement describes the effect of meiosis on chromosome number?

- A** A diploid parent cell produces diploid daughter cells.
- B** A diploid parent cell produces haploid daughter cells.
- C** A haploid parent cell produces diploid daughter cells.
- D** A haploid parent cell produces haploid daughter cells.

33 Four features of cell division are listed.

- 1 Haploid cells are produced.
- 2 New cells are genetically identical.
- 3 It is a reduction division.
- 4 It results in variation.

Which features would be associated with meiosis?

- A** 1, 2 and 3 **B** 1, 2 and 4 **C** 1, 3 and 4 **D** 2, 3 and 4

- 29** A female with red-green colour blindness has a child with a male who does **not** have red-green colour blindness. The child is male.

What is the chance of this child having red-green colour blindness?

- A** 0% **B** 25% **C** 50% **D** 100%

IGCSE Biology: w25 22

- 29** Which chromosomes can be found in a single sperm?

- A** X and X **B** X and Y **C** X or X **D** X or Y

IGCSE Biology: w25 23

- 31** Polydactyly in cats is a dominant condition that causes affected cats to be born with extra toes.

What is the probability of two cats that are heterozygous for polydactyly having an offspring with **no** extra toes?

- A** 0.125 **B** 0.25 **C** 0.50 **D** 0.75

IGCSE Biology: s25 23

- 30** Which name is given to different versions of a gene?

- A** allele
B chromosome
C length of DNA
D protein

IGCSE Biology: m25 22

- 32** A man with blood group A and genotype $I^A I^O$ has a child with a woman who has blood group B and genotype $I^B I^O$.

What is the probability of the child having blood group O?

- A** 0.00 **B** 0.25 **C** 0.50 **D** 1.00

18 Variation and mutation – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
Variation	变异	_____	_____	_____
species	物种	_____	_____	_____
continuous variation	连续变异	_____	_____	_____
genes	基因	_____	_____	_____
environment	环境	_____	_____	_____
discontinuous variation	不连续变异	_____	_____	_____
blood groups	血型	_____	_____	_____
mutation	突变	_____	_____	_____
alleles	等位基因	_____	_____	_____
Ionising radiation	电离辐射	_____	_____	_____
rate	速率	_____	_____	_____

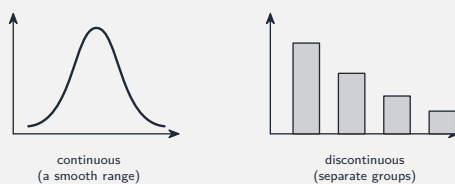
Recall

Variation 变异 means the differences between individuals of the same **species** 物种.

New ideas

Read these first, then do the Practice.

■ 1 Two kinds of variation



- **continuous variation** 连续变异—a smooth range (e.g. height); caused by **genes** 基因 and the **environment** 环境;
- **discontinuous variation** 不连续变异—a few separate groups (e.g. **blood groups** 血型); caused by genes only.

■ 2 Mutation

A **mutation** 突变 is a random change in the DNA. It makes **new alleles** 等位基因—the source of all variation:



Ionising radiation 电离辐射 (e.g. X-rays) and some chemicals raise the **rate** 速率 of mutation.

Watch out: **continuous** variation is a smooth range (e.g. height), caused by *genes and environment*; **discontinuous** variation falls into separate groups (e.g. blood group), caused by *genes only*. A **mutation** is a random DNA change—the source of new alleles.

Practice

Try these in order.

18.1 What is *variation*? [1]

18.2 Give one example of continuous variation. [1]

18.3 What two things cause continuous variation? [1]

18.4 What is a *mutation*?

[1]

18.5 Name one thing that increases the rate of mutation.

[1]

18.6 Challenge. Height is continuous but blood group is discontinuous. Explain the difference in how each is caused.

[2]

30 What is a source of genetic variation that alters the base sequence of DNA?

- A** gene mutation
- B** mitosis
- C** random fertilisation
- D** random mating

32 What is a way in which new alleles are formed?

- A** artificial selection
- B** mutation
- C** natural selection
- D** sexual reproduction

33 What are sources of genetic variation in populations?

- A** meiosis, mutation, random mating
- B** meiosis, random mating, asexual reproduction
- C** mitosis, mutation, random fertilisation
- D** mitosis, random fertilisation, asexual reproduction

18 Selection – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
adapted	适应	_____	_____	_____
reproduce	繁殖	_____	_____	_____
Antibiotic-resistant	耐药	_____	_____	_____
bacteria	细菌	_____	_____	_____
selective breeding	选择育种	_____	_____	_____
crops	农作物	_____	_____	_____

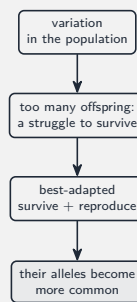
Recall

New alleles from mutation, plus the struggle to survive, drive how species change over time.

New ideas

Read these first, then do the Practice.

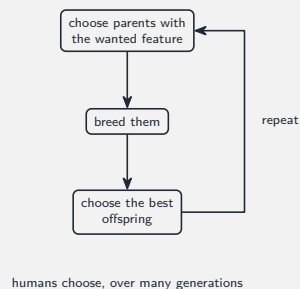
■ 1 Natural selection



The individuals best **adapted** 适应 to the environment are more likely to survive and **reproduce** 繁殖, so their helpful alleles spread. **Antibiotic-resistant** 耐药 **bacteria** 细菌 are a real example.

■ 2 Selective breeding

In **selective breeding** 选择育种, **humans** choose which organisms breed:



This improves **crops** 农作物 (higher yield) and farm animals (more milk). The key difference: in natural selection the **environment** chooses; in selective breeding humans choose.

Watch out: in **natural selection** the *environment* chooses which survive; in **selective breeding** *humans* choose which breed —same idea, different chooser. The helpful **alleles** of the survivors become more common over generations.

Practice

Try these in order.

18.6 In natural selection, which individuals are most likely to survive? [1]

18.7 What happens to the alleles of the survivors? [1]

18.8 Give a real example of natural selection. [1]

18.9 In selective breeding, who chooses which organisms breed? [1]

18.10 Give one use of selective breeding. [1]

18.11 Challenge. A farmer wants cows that give more milk. Describe how selective breeding could achieve this over several generations. [3]

34 What are features of hydrophytes which have leaves that float?

- A** long root system
- B** many stomata on upper surface of leaves
- C** hairy leaves
- D** small air spaces in the spongy mesophyll

IGCSE Biology: **w25 23**

34 Which term is used to describe a characteristic that helps an organism to survive and reproduce in its environment?

- A** adaptive feature
- B** competition
- C** observable feature
- D** phenotype

IGCSE Biology: **s25 23**

34 Which statements describe an adaptive feature in an organism?

- 1 It helps an organism to survive and reproduce in its environment.
- 2 It always shows continuous variation.
- 3 It is inherited.

- A** 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

33 Which row correctly describes a type of selection?

	type of selection	humans involved	example
A	artificial	no	production of farmed animals that produce lots of milk
B	artificial	yes	production of bacteria that are resistant to antibiotics
C	natural	yes	production of insulin through genetic modification of bacteria
D	natural	no	production of wild animals with long necks to reach tree leaves as a food source

27 *Clostridium difficile* is a species of bacterium that is resistant to many antibiotics.

From 2002 to 2006, the number of people in one country infected with *Clostridium difficile* increased from 1300 to 6200 people.

What was the percentage increase in the number of people infected with *Clostridium difficile* from 2002 to 2006 to the nearest whole number?

- A** 21% **B** 27% **C** 79% **D** 377%

33 How does artificial selection differ from natural selection?

- A** Artificial selection changes the characteristics of living things.
B Artificial selection is based on genetic variation.
C Artificial selection does **not** involve competition for resources.
D Artificial selection occurs over many generations.

19 Food chains and energy – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
energy	能量	_____	_____	_____
food chain	食物链	_____	_____	_____
producer	生产者	_____	_____	_____
consumers	消费者	_____	_____	_____
food web	食物网	_____	_____	_____
decomposer	分解者	_____	_____	_____
trophic level	营养级	_____	_____	_____

Recall

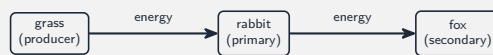
The **Sun** is the source of **energy** 能量 for almost all life. Energy flows from organism to organism as they feed, and is lost as heat at each step.

New ideas

Read these first, then do the Practice.

■ 1 Food chains

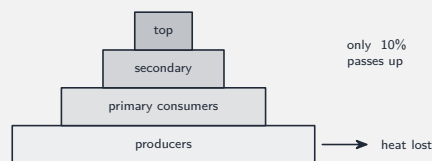
A **food chain** 食物链 shows energy passing from a **producer** 生产者 to **consumers** 消费者. The arrows show the way the energy flows:



A **food web** 食物网 is many food chains linked together. A **decomposer** 分解者 feeds on dead matter.

■ 2 Energy pyramids

A **trophic level** 营养级 is a feeding position. Only about **10%** of the energy passes to the next level (the rest is lost as heat), so the levels get smaller:



This is why food chains are short, and why eating plants is more energy-efficient.

Watch out: arrows in a food chain show the way **energy flows** (eaten → eater), not who eats whom. Only about **10%** of the energy passes to the next level (the rest is lost as heat), which is why food chains are short.

Practice

Try these in order.

19.1 What does an arrow in a food chain show? [1]

19.2 What is a *producer*? [1]

19.3 In the chain grass → rabbit → fox, which is the secondary consumer? [1]

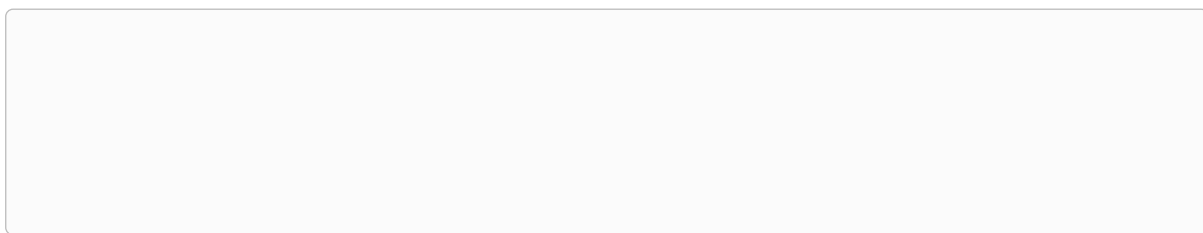
19.4 About what percentage of energy passes from one trophic level to the next? [1]

19.5 Why are most food chains short (fewer than five levels)? [1]

19.6 Challenge. A field can feed more people if they eat the wheat directly than if the

wheat is fed to cattle and the people eat the beef. Explain why.

[2]



35 Which unit could be used for the measurements needed to construct a pyramid of energy?

- A** kJ per g per m²
- B** kJ per kg per year
- C** kJ per m² per year
- D** kJ per kg

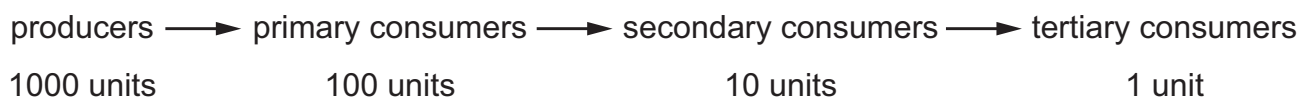
IGCSE Biology: **s25 21**

34 Which statement about a pyramid of energy for a food chain is correct?

- A** It shows how energy is lost at each trophic level.
- B** It shows the energy stored at each trophic level.
- C** It shows the input of energy from the principal source.
- D** It shows the total energy stored within an ecosystem.

IGCSE Biology: **s25 23**

36 The diagram shows the flow of energy, in units of energy, through a food chain.



Which percentage of energy is lost between the producers and secondary consumers?

- A** 1%
- B** 10%
- C** 90%
- D** 99%

33 Which statements about a food chain are correct?

- 1 Between trophic level 1 and trophic level 2, energy is passed from a herbivore to a carnivore.
- 2 Between trophic level 2 and trophic level 3, energy is passed from a primary consumer to a secondary consumer.
- 3 Between trophic level 3 and trophic level 4, energy is passed from a secondary consumer to a tertiary consumer.

A 1 and 3 **B** 1 only **C** 2 and 3 **D** 2 only

IGCSE Biology: **w25 23**

38 In which trophic level are herbivores found?

- A** primary consumers
- B** quaternary consumers
- C** secondary consumers
- D** tertiary consumers

IGCSE Biology: **m25 22**

36 Which organisms can be sources of energy for decomposers?

	producers	herbivores	carnivores
A	✓	✓	✓
B	✓	✗	✗
C	✗	✓	✓
D	✗	✗	✗

key
 ✓ = yes
 ✗ = no

19 Carbon cycle and populations – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
carbon cycle	碳循环	_____	_____	_____
photosynthesis	光合作用	_____	_____	_____
carbon dioxide	二氧化碳	_____	_____	_____
respiration	呼吸作用	_____	_____	_____
combustion	燃烧	_____	_____	_____
population	种群	_____	_____	_____
species	物种	_____	_____	_____
lag	延迟期	_____	_____	_____
exponential	对数期	_____	_____	_____
stationary	稳定期	_____	_____	_____
death	衰亡期	_____	_____	_____

Recall

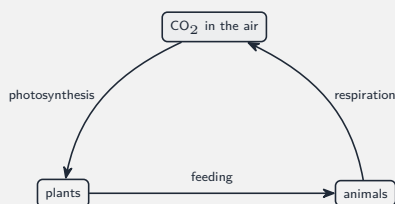
Energy flows one way and is lost, but nutrients like carbon are **recycled** —used again and again.

New ideas

Read these first, then do the Practice.

■ 1 The carbon cycle

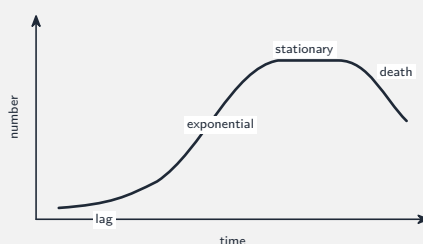
In the **carbon cycle** 碳循环, carbon moves between the air and living things:



- **photosynthesis** 光合作用 takes **carbon dioxide** 二氧化碳 out of the air;
- **respiration** 呼吸作用 and **combustion** 燃烧 (burning) return it.

■ 2 Population growth

A **population** 种群 is a group of one **species** 物种 in one area. With limited food and space, it grows in an S-shape:



- **lag** 延迟期 (slow start) → **exponential** 对数期 (fast) → **stationary** 稳定期 (levels off) → **death** 衰亡期 (falls).

Watch out: in the carbon cycle, **photosynthesis** *removes* carbon dioxide from the air, while **respiration, combustion and decomposition** *return* it —keep the directions straight. A population grows in an S-shape: lag → exponential → stationary → death.

Practice

Try these in order.

19.6 Which process removes carbon dioxide from the air?

[1]

19.7 Name two processes that return carbon dioxide to the air.

[2]

19.8 What is a *population*? [1]

19.9 In which phase does a population grow fastest? [1]

19.10 What happens in the death phase, and why? [2]

19.11 Challenge. A few bacteria are placed in a flask of food. Describe and explain how their numbers change over time, naming the phases. [3]

34 Which process in the nitrogen cycle is involved in the breakdown of amino acids in living organisms?

- A** deamination
- B** decomposition
- C** denitrification
- D** digestion

36 Which process needs microorganisms to break down protein to produce ammonium ions?

- A** decomposition
- B** denitrification
- C** nitrification
- D** nitrogen fixation

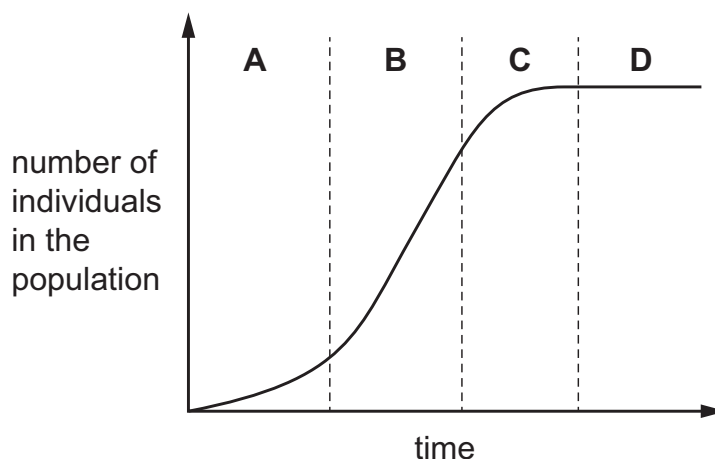
35 Which process removes carbon dioxide from the atmosphere?

- A** combustion
- B** decomposition
- C** photosynthesis
- D** respiration

37 Which process in the nitrogen cycle can be caused by lightning and bacteria?

- A** deamination
- B** denitrification
- C** nitrification
- D** nitrogen fixation

37 Which letter represents the lag phase in the population graph shown?



37 A coral reef contains species such as stony corals, sponges, seahorses and whale sharks.

These species interact with each other and are affected by the temperature, salt concentration and oxygen concentration of the water.

Using all the information given, what is being described?

- A** community
- B** ecosystem
- C** food web
- D** population

38 What can cause an increase in the size of a rabbit population?

- A** an increase in a disease that affects rabbits
- B** an increase in available food for the rabbits
- C** an increase in pollution in the habitat of the rabbits
- D** an increase in predation of rabbits

20 Food supply and deforestation – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
environment	环境	_____	_____	_____
fertilisers	化肥	_____	_____	_____
yields	产量	_____	_____	_____
insecticides	杀虫剂	_____	_____	_____
herbicides	除草剂	_____	_____	_____
weeds	杂草	_____	_____	_____
monoculture	单一栽培	_____	_____	_____
biodiversity	生物多样性	_____	_____	_____
Deforestation	森林砍伐	_____	_____	_____

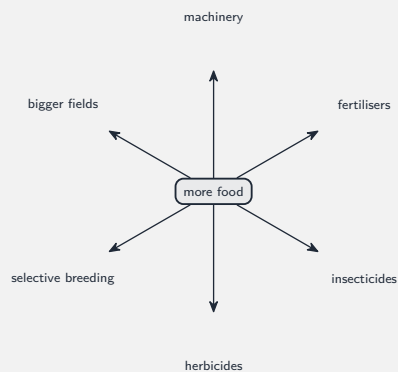
Recall

To feed a growing population, humans grow more food —but this can harm the **environment** 环境.

New ideas

Read these first, then do the Practice.

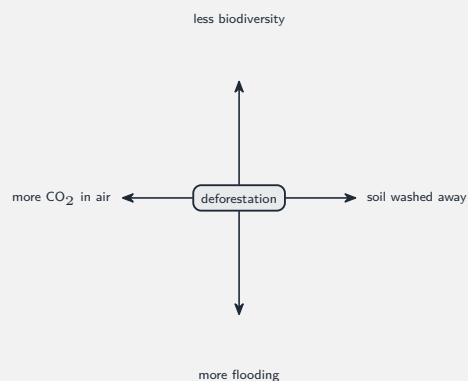
■ 1 Growing more food



- **fertilisers** 化肥 improve **yields** 产量; **insecticides** 杀虫剂 kill pests; **herbicides** 除草剂 kill **weeds** 杂草;
- a **monoculture** 单一栽培 (one crop over a big area) gives an easy harvest but lowers **biodiversity** 生物多样性.

■ 2 Deforestation

Deforestation 森林砍伐 (cutting down forests) does great harm:



Watch out: **insecticides** kill insect pests; **herbicides** kill weeds —different targets. A **monoculture** gives an easy harvest but lowers **biodiversity** and lets one pest wipe out the whole crop.

Practice

Try these in order.

20.1 What do fertilisers do?

[1]

20.2 What is the difference between an insecticide and a herbicide? [2]

20.3 Give one disadvantage of a monoculture. [1]

20.4 What is *deforestation*? [1]

20.5 Give two harms caused by deforestation. [2]

20.6 Challenge. A farmer plants a huge field with a single crop (a monoculture). Give one advantage and one disadvantage of doing this. [2]

38 What is an **advantage** of large scale monocultures?

- A** increased biodiversity
- B** increased crop yield
- C** increased susceptibility to disease
- D** increased variation in the crop plant

IGCSE Biology: **s25 22**

39 When managing fish stocks as a **sustainable resource**, what is a reason for harvesting only the larger fish of a particular species?

- A** Larger fish are easier to harvest.
- B** Larger fish sell at a higher price.
- C** Smaller fish are eaten by predators.
- D** Smaller fish are too young to breed.

IGCSE Biology: **s25 23**

39 What is a **disadvantage** of large-scale monocultures of crop plants?

- A** a decrease in use of insecticides
- B** a decrease in fossil fuel emissions
- C** an increase in biodiversity
- D** an increase in risk of disease destroying the entire crop

- 6 In Fig. 6.1, the diagrams of an island show the land covered by forest in 1982 and 2013.

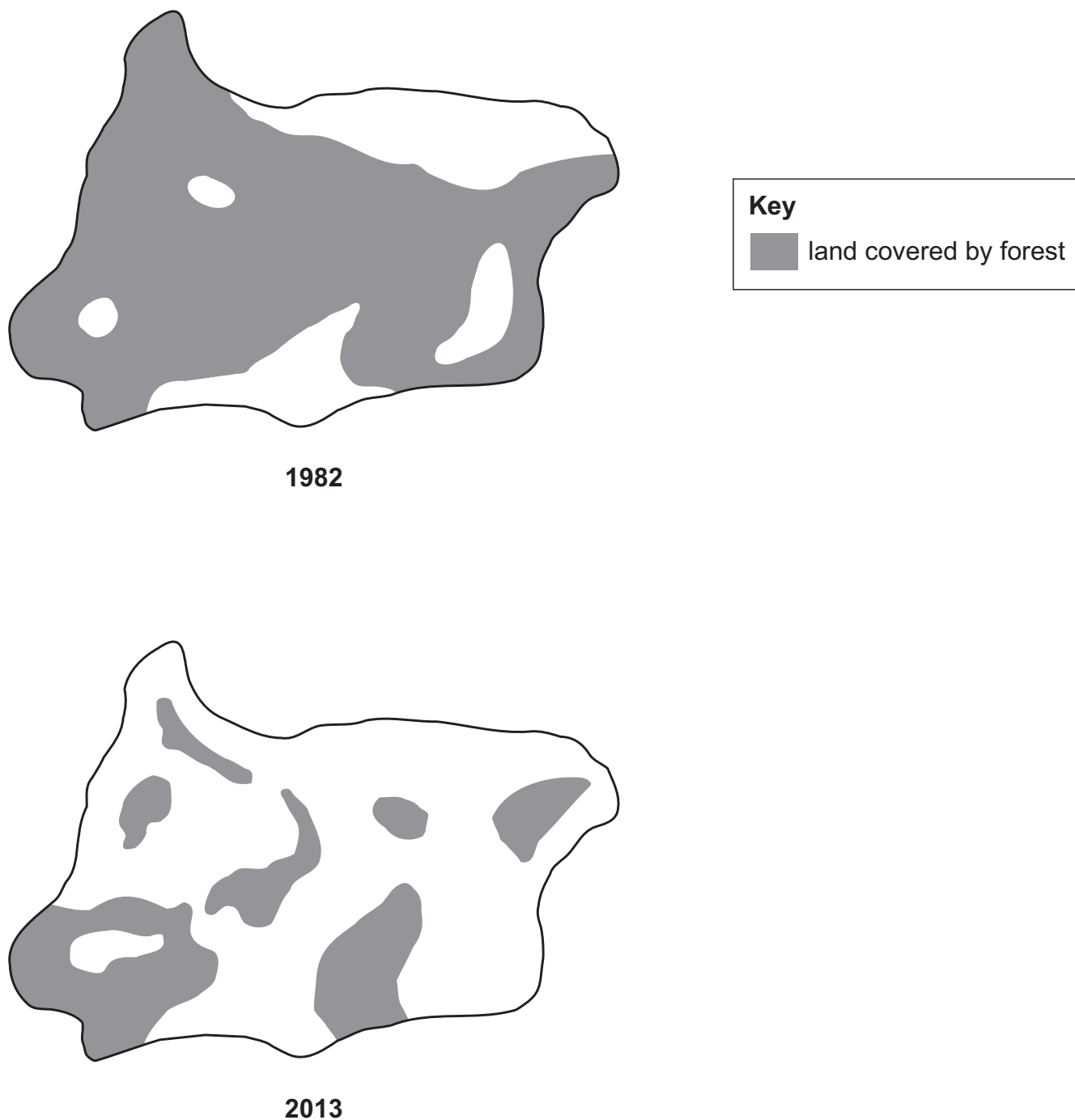


Fig. 6.1

- (a) (i) Describe the change in land covered by forest between 1982 and 2013 in Fig. 6.1.

.....

.....

.....

.....

..... [2]

(ii) State **two** possible causes for the change in land covered by forest in Fig. 6.1.

1

.....

2

.....

[2]

(b) Fig. 6.2 is a diagram of the carbon cycle.

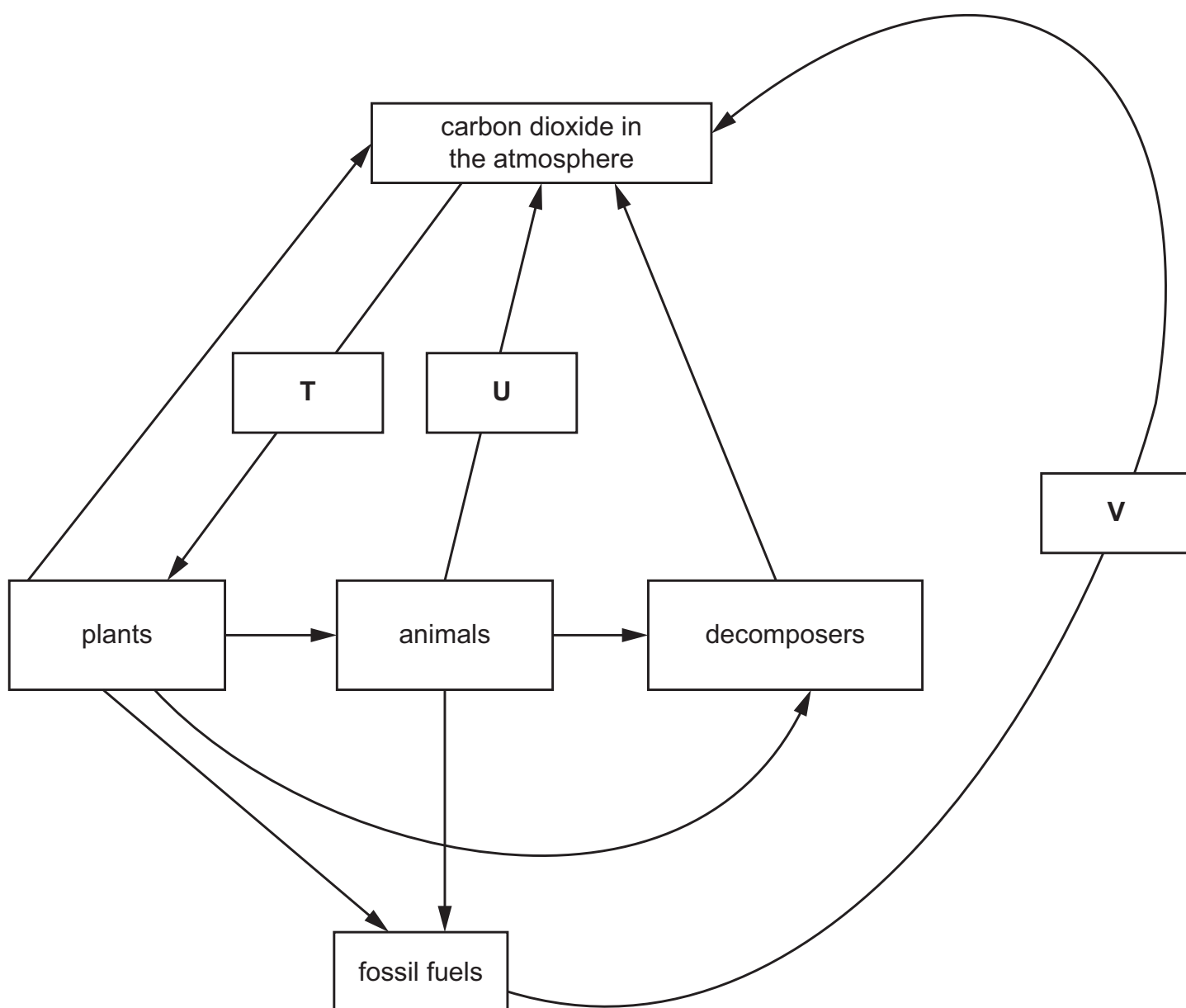


Fig. 6.2

State the names of the processes labelled **T**, **U** and **V** in Fig. 6.2.

T

U

V

(c) Deforestation is linked to an increase in global temperatures.

(i) Explain how deforestation can contribute to an increase in global temperatures.

[3]

(ii) Describe **other** undesirable effects of deforestation.

[3]

[Total: 13]

20 Pollution and conservation – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
fertiliser	化肥	_____
eutrophication	富营养化	_____
oxygen	氧气	_____
Greenhouse gases	温室气体	_____
carbon dioxide	二氧化碳	_____
methane	甲烷	_____
climate change	气候变化	_____
conservation	保护	_____
quotas	配额	_____

Recall

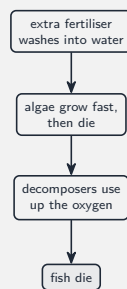
Human activities can pollute water and air, harming ecosystems.

New ideas

Read these first, then do the Practice.

■ 1 Eutrophication

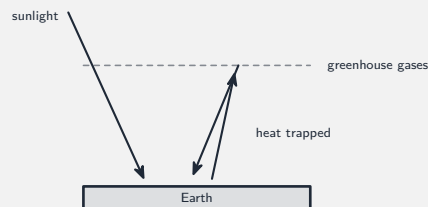
Extra **fertiliser** 化肥 washed into water causes **eutrophication** 富营养化:



The water loses its **oxygen** 氧气, so fish and other organisms die.

■ 2 The greenhouse effect

Greenhouse gases 温室气体 (such as **carbon dioxide** 二氧化碳 and **methane** 甲烷) trap heat leaving the Earth:



Too much of these gases strengthens the greenhouse effect, causing **climate change** 气候变化. We protect nature through **conservation** 保护—protected areas, **quotas** 配额 and replanting.

Watch out: in **eutrophication** extra fertiliser makes algae bloom; when they die, decomposers use up the **oxygen**, so fish suffocate. Greenhouse gases (carbon dioxide, methane) **trap heat** leaving the Earth, strengthening the greenhouse effect.

Practice

Try these in order.

20.6 What causes eutrophication?

[1]

20.7 In eutrophication, why do the fish die?

[2]

20.8 Name two greenhouse gases. [2]

20.9 What do greenhouse gases do to the heat leaving the Earth? [1]

20.10 Give one way we conserve nature. [1]

20.11 Challenge. Fertiliser from a field washes into a nearby lake, and weeks later the fish die. Explain the chain of events. [3]

37 Eutrophication results in a reduction in the dissolved oxygen in streams and lakes.

What causes the reduction in dissolved oxygen?

- A** decreased aerobic respiration by decomposers
- B** decreased aerobic respiration by fish
- C** increased aerobic respiration by decomposers
- D** increased aerobic respiration by fish

39 Which source of pollution can cause eutrophication?

- A** carbon dioxide
- B** methane
- C** non-biodegradable plastic
- D** sewage

39 How does eutrophication lead to the death of fish?

- A** A sudden increase in the number of bacteria increases the spread of disease.
- B** Algae respire instead of photosynthesise.
- C** Decomposer bacteria lower the oxygen concentration in the water.
- D** Fertilisers reduce the availability of nitrates in the water.

31 Which technique is **not** used to conserve endangered animal species?

- A** artificial insemination
- B** captive breeding programmes
- C** *in vitro* fertilisation
- D** seed banks

38 Which term describes the number of different species living in an area?

- A** biodiversity
- B** conservation
- C** ecosystem
- D** population

21 Biotechnology – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
Biotechnology	生物技术	_____	_____	_____
enzymes	酶	_____	_____	_____
Bacteria	细菌	_____	_____	_____
plasmids	质粒	_____	_____	_____
Yeast	酵母	_____	_____	_____
anaerobic respiration	无氧呼吸	_____	_____	_____
ethanol	乙醇	_____	_____	_____
biofuel	生物燃料	_____	_____	_____
pectinase	果胶酶	_____	_____	_____
washing powders	洗衣粉	_____	_____	_____

Recall

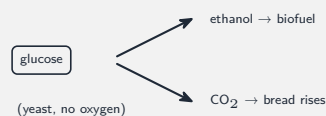
Biotechnology 生物技术 uses living things (or their **enzymes** 酶) to make useful products. **Bacteria** 细菌 are useful because they reproduce fast and contain **plasmids** 质粒 (small DNA rings).

New ideas

Read these first, then do the Practice.

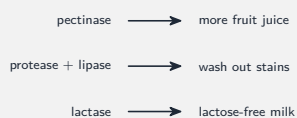
■ 1 Yeast

Yeast 酵母 carries out **anaerobic respiration** 无氧呼吸 (without oxygen), making **ethanol** 乙醇 and carbon dioxide:



- the ethanol is a **biofuel** 生物燃料;
- the carbon dioxide makes bread dough rise.

■ 2 Enzymes in industry



- **pectinase** 果胶酶 releases more juice from fruit;
- biological **washing powders** 洗衣粉 contain enzymes that digest stains.

Watch out: yeast respire *anaerobically* to make **ethanol** (a biofuel) and **carbon dioxide** (which makes bread rise) —one reaction, two useful products. Industrial enzymes like **pectinase** (more juice) and the protease/lipase in washing powder work outside living cells.

Practice

Try these in order.

21.1 What is *biotechnology*? [1]

21.2 Give two reasons bacteria are useful in biotechnology. [2]

21.3 What two products does yeast make in anaerobic respiration? [2]

21.4 Give one use of the ethanol that yeast makes. [1]

21.5 What does pectinase do? [1]

21.6 Challenge. Bakers and brewers both use yeast, but they want different products from it. Explain what each one wants. [2]

39 Why is pectinase useful in fruit juice production?

- A** Cloudier juice is produced.
- B** More juice can be extracted from the fruits.
- C** Proteins in the fruit are digested.
- D** Starch is digested to produce more sugar.

40 Which features make bacteria useful in biotechnology?

- 1 They are unaffected by antibiotics.
- 2 They do **not** contain plasmids.
- 3 They make complex molecules.
- 4 They reproduce rapidly.

- A** 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

21 Fermenters and GM – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)
fermenter	发酵罐	_____
insulin	胰岛素	_____
penicillin	青霉素	_____
temperature	温度	_____
oxygen	氧气	_____
Genetic modification	基因改造	_____
crops	农作物	_____
resistance	抗性	_____

Recall

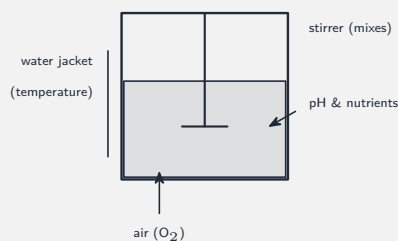
Bacteria and fungi can be grown in large tanks, and their genes can even be changed to make human proteins.

New ideas

Read these first, then do the Practice.

■ 1 Fermenters

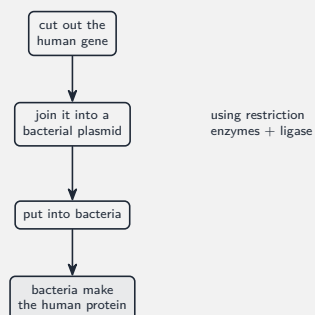
A **fermenter** 发酵罐 is a large tank used to grow microbes to make products such as **insulin** 胰岛素 and **penicillin** 青霉素. The conditions are carefully controlled:



The **temperature** 温度, pH, **oxygen** 氧气 and nutrients must all be kept right.

■ 2 Genetic modification

Genetic modification 基因改造 means changing an organism's genes. To make a human protein (e.g. insulin) in bacteria:



GM **crops** 农作物 can be given **resistance** 抗性 to herbicides or insect pests.

Watch out: a **fermenter** keeps temperature, pH, oxygen and nutrients controlled so the microbes make the most product. **Genetic modification** moves a gene (e.g. the human insulin gene) into bacteria, using a **plasmid** as the carrier.

Practice

Try these in order.

21.6 What is a *fermenter* used for? [1]

21.7 Name two products made in fermenters. [2]

21.8 Name two conditions that must be controlled in a fermenter. [2]

21.9 What is *genetic modification*?

[1]

21.10 Give one example of how genetic modification is used.

[1]

21.11 Challenge. Outline the main steps used to make human insulin in bacteria by genetic modification.

[3]

40 Some of the processes involved in the production of insulin by genetic modification are listed.

- 1 cutting of bacterial plasmid DNA with restriction enzymes
- 2 expression in bacteria of the human gene to make insulin
- 3 insertion of recombinant plasmids into bacteria
- 4 multiplication of bacteria containing recombinant plasmids

In which order do these processes occur?

- A** 1 → 3 → 4 → 2
- B** 2 → 1 → 3 → 4
- C** 3 → 1 → 2 → 4
- D** 4 → 1 → 3 → 2

40 The diagram shows a bacterial cell.

Which cell structure makes bacteria useful in genetic modification?

