

1.2 Cells as the basic units of living organisms

Name: _____ Class: _____ Date: _____ **Total: 34 marks**

KEY WORDS organelle 细胞器 • cell wall 细胞壁 • prokaryotic 原核 • prokaryotic cell 原核细胞
• cell surface membrane 细胞膜

Objective

Build the skills to answer exam questions on **cells as the basic units of living organisms** — identifying **organelles** 细胞器, comparing plant, animal and **prokaryotic** 原核 cells, and describing viruses.

You must be able to:

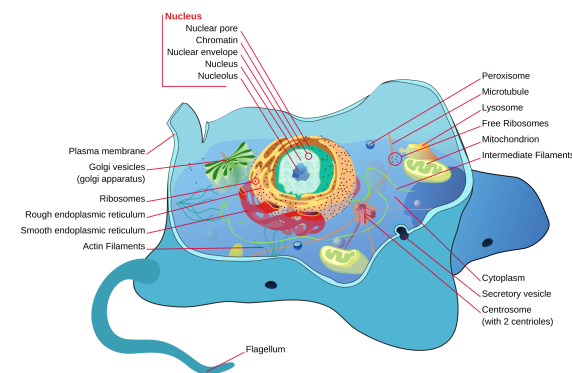
- name organelles from their structure and give their function
- compare a typical plant cell with a typical animal cell
- compare a **prokaryotic cell** with a **eukaryotic cell** 真核细胞
- state that a virus is non-cellular, with a nucleic acid core and a protein **capsid** 衣壳

1 Worked examples

Study these first. Each shows the **method** 方法 for a question type used later.

■ Identifying an organelle from its features

Match the clues — shape, membranes, contents — to one organelle, then give its job.
Learn to recognise each organelle in the diagram below.

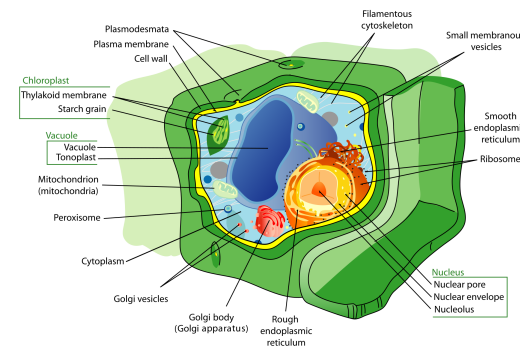


A generalised animal cell — recognise each organelle by its shape and position

Example. “This organelle is oval, has a folded inner membrane, and contains small circular DNA and 70S ribosomes.” → It is a **mitochondrion** 线粒体. Its function is **aerobic respiration** 有氧呼吸 — releasing energy as ATP. (The folded inner membrane and own circular DNA are the give-away clues.)

■ Answering a “compare” question

“Compare” means give points that mention **both** sides, and include at least one **similarity**.



A plant cell — note the features an animal cell does not have

Example — plant vs animal cell. Write paired statements:

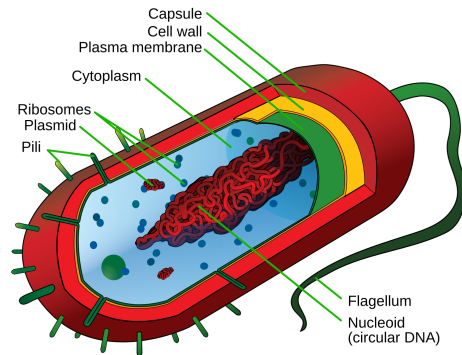
- a plant cell has a **cellulose** 纤维素 cell wall; an animal cell has none.
- a plant cell has **chloroplasts** 叶绿体; an animal cell has none.
- a plant cell has one large permanent **vacuole** 液泡; an animal cell has only small,

temporary ones.

- **both** have a cell surface membrane, cytoplasm, a nucleus and mitochondria.

■ Comparing prokaryotic and eukaryotic cells

A **prokaryotic cell** (a bacterium) has no nucleus and no membrane-bound organelles.



A prokaryotic cell: circular DNA lies free in the cytoplasm; 70S ribosomes; no nucleus

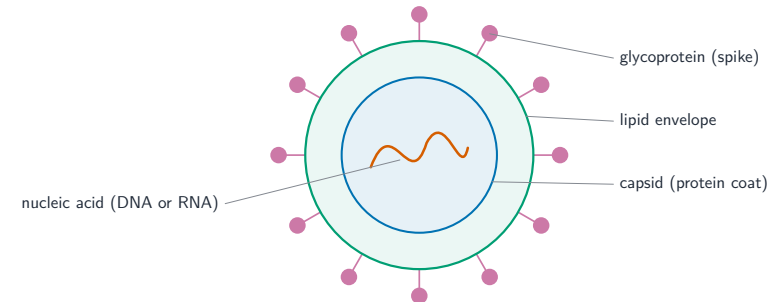
The key differences examiners reward:

feature	prokaryotic cell	eukaryotic cell
nucleus	none (DNA free in cytoplasm)	true nucleus with envelope
DNA	circular, no histones 组蛋白	linear, wound on histones
ribosomes	70S	80S (in the cytoplasm)
membrane-bound organelles	absent	present (mitochondria, ER, Golgi)
size	1–5 μm	10–100 μm

Both have a cell surface membrane, cytoplasm, ribosomes and DNA. (A prokaryote also has a wall, but of **peptidoglycan** 肽聚糖, not cellulose.)

■ Viruses are non-cellular

A virus is **not** a cell. It has only a **nucleic acid** 核酸 core (DNA or RNA) inside a protein **capsid**; some also have an outer phospholipid **envelope** 包膜.



A generalised virus: nucleic acid core, protein capsid, and (in some) a lipid envelope

It has no cytoplasm, no organelles and no ribosomes, so it cannot release energy or make proteins on its own.

2 Practice

2.1 Name the organelle that carries out each function. [4]

function	organelle
makes and transports proteins (has ribosomes on it)	
packs and modifies proteins into vesicles	
site of photosynthesis	
breaks down old organelles and waste	

2.2 State **three** structures found in a plant cell that are **not** found in a typical animal cell. [3]

2.3 Give the size (S value) of the ribosomes found in (a) the cytoplasm of a eukaryotic cell, and (b) a prokaryotic cell. [2]

3 Exam-style questions

3.1 Which structures are found in **both** a prokaryotic cell and a eukaryotic cell? [1]

- A cell surface membrane, cytoplasm, ribosomes
- B mitochondria, nucleus, ribosomes
- C chloroplasts, cell wall, vacuole
- D nuclear envelope, Golgi body, lysosomes

3.2 An organelle has a **double membrane** and contains small **circular DNA**. Which organelle could it be? [1]

- A lysosome
- B mitochondrion
- C ribosome
- D smooth endoplasmic reticulum

3.3 Which feature is present in a prokaryotic cell but **not** in a eukaryotic cell? [1]

- A 70S ribosomes only
- B a cell surface membrane
- C a Golgi body
- D linear DNA wound on histones

3.4 A student views an electron micrograph of an animal cell.

(a) One organelle is described as “*a stack of flat membrane sacs near the nucleus*”. Name this organelle and state its function. [2]

(b) Another organelle has “*sheets of membrane covered with ribosomes*”. Name it and state what it makes. [2]

3.5 The diagram of the prokaryotic cell above shows several features. Compare the structure of a prokaryotic cell with that of a eukaryotic cell. Give **two** differences and **one** similarity. [3]

3.6 Describe the structure of a virus. [3]

3.7 An electron micrograph shows a cell containing many mitochondria, an extensive network of rough endoplasmic reticulum, a large Golgi body, numerous vesicles at the cell surface, and no cell wall.

(a) State, with **three** pieces of evidence from the description, whether this is a prokaryotic or a eukaryotic cell. [3]

(b) Suggest the function of this cell, and justify your suggestion using **two** of the organelles named. [3]

(c) Describe the route taken by a protein from the gene that codes for it to the outside of the cell, naming each organelle involved. [4]

(d) State **two** reasons why the mitochondria could not have been seen in this detail with a light microscope. [2]

Solutions

2.1 rough endoplasmic reticulum; Golgi body (Golgi apparatus); chloroplast; lysosome.

2.2 Any three of: cellulose cell wall; chloroplasts; large permanent vacuole (tonoplast); plasmodesmata.

2.3 (a) 80S; (b) 70S.

3.1 A. A cell surface membrane, cytoplasm and ribosomes occur in all cells; the others are eukaryote-only.

3.2 B. Mitochondria (and chloroplasts) have a double membrane and their own circular DNA.

3.3 A. Prokaryotes have only 70S ribosomes; the cell surface membrane is in both, and a Golgi body and histone-wound linear DNA are eukaryote features.

3.4 (a) Golgi body / Golgi apparatus; modifies and packages proteins/lipids into vesicles for secretion.

(b) rough endoplasmic reticulum; makes (and transports) proteins.

3.5 Two differences, e.g. prokaryote has no nucleus while eukaryote has a true nucleus; prokaryote has 70S ribosomes while eukaryote has 80S; prokaryote has no membrane-bound organelles while eukaryote does. One similarity, e.g. both have a cell surface membrane / cytoplasm / ribosomes / DNA.

3.6 A nucleic acid core, either DNA or RNA; surrounded by a protein coat called a capsid; some have an outer phospholipid envelope / it is non-cellular with no organelles.

3.7 (a) Eukaryotic. It has membrane-bound organelles — mitochondria and a Golgi body — which prokaryotes lack; it has rough endoplasmic reticulum, again absent in prokaryotes. (The absence of a cell wall additionally suggests an animal cell.)

(b) A secretory cell — for example a gland cell producing enzymes or hormones. The extensive rough ER means very high rates of protein synthesis; the many mitochondria supply the ATP for that synthesis and for moving the vesicles.

(c) The gene is transcribed to mRNA in the **nucleus**; the mRNA is translated by **ribosomes** on the rough ER, and the protein enters the ER lumen; vesicles carry it to the **Golgi body**, where it is modified and packaged; Golgi vesicles then fuse with the **cell surface membrane**, releasing the protein by exocytosis.

(d) A light microscope resolves only to about 200 nm, limited by the wavelength of light, so internal detail cannot be separated; its maximum useful magnification, about $\times 1500$, is far too low — electrons have a much shorter wavelength and resolve to about 0.5 nm.